



THE  
CASTLE  
OF  
KNOWLEDGE

1556











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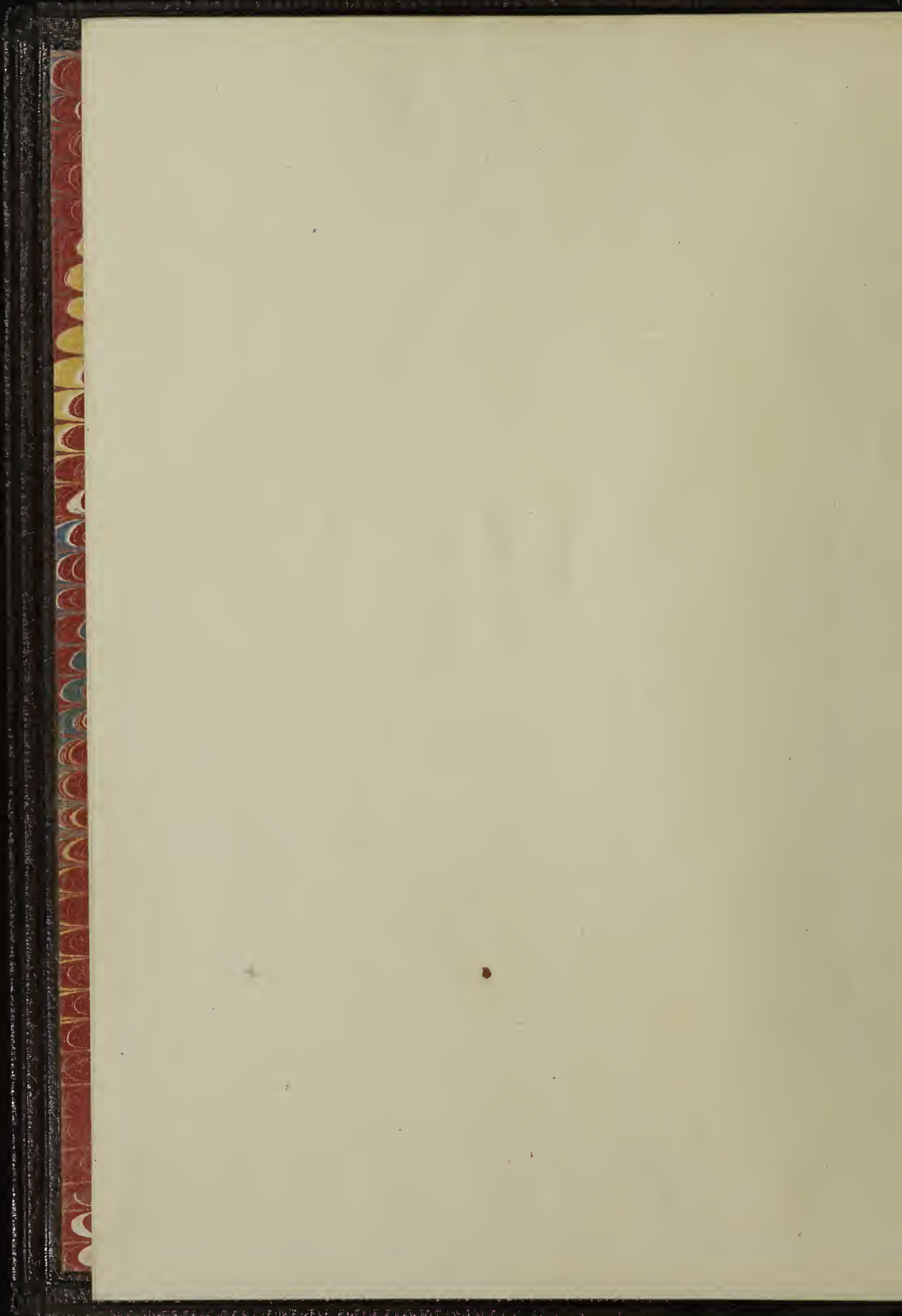
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REYNOLD WOLF PRINTER.

# The Castle of Knowledge.

The Sphere of  
Destinye.

The wheele  
of Fortune.

Sphæra Fati

Sphæra Fortuna.

whose go- uernour  
is Know ledge.

whose ruler is  
Ignorance.

TO KNOWLEDGE is this Trophy set,  
All learninges friendes will it support.  
So shall their name great honour get,  
And gaine great fame with good report.

Though spitefull Fortune turned her wheele  
To staye the Sphere of Vraney,  
Yet dooth this Sphere resist that wheele,  
And sleeyth all fortunes villanye.  
Though earthe do honour Fortunes balle,  
And bytells blynde hyr wheele aduance,  
The heauens to fortune are not thralle,  
These Spheres surmount al fortunes chance.

*The contentes in brieft of the 4 Treatises of*  
**THE CASTLE OF KNOWLEDGE**  
CONTAINING THE EXPLICATION OF THE SPHERE  
bothe celestiaall and materiaall, and diuers other  
thinges incident therto. With sundry plea-  
saunt pzoofes and certaine newe demon-  
strations not wzitten befoze in any  
vulgare woorkes.

The first treatise is an introduction into the Sphere, de-  
claringe the necessarye partes of it, as well for the materiaall  
Sphere, as for the celestiaall: And that no partes of it are  
admitted without profitable vse.

The seconde treatise doothe teache the makinge of the  
sphere, as well in sound and massye forme, as also in Ringe  
forme, with hoopes: And the proportions of eche of them  
iustly described.

The thyrde treatise dooth briefly declare certain thinges  
appertaininge to the vse of the Sphere, and other matters  
thervnto incidente: without prooffe or demonstration: and  
that briefly, for easinesse in learninge and remembringe.

The fourthe treatise doth approue manye thinges, that  
were noted in other partes before: and beside then addeth  
diuers other maters, concerninge the necessarye vse of the  
sphere, whiche were not touched before, and doth bring de-  
monstration or other certaine prooffe for the perswadinge  
of them: wherein are many Tables set forth very pleasaunte  
and profitable.

*If ought here want, that you desire,  
Remembre where this woork was wrought:  
In Plutos forge with scarce good fier,  
This rustye Sphere to eande was brought.  
But if I may it fyle agene,  
The ruste I truste to scour of clene.*

# AN ADMONITION FOR THE ordely trade of studie in the Authors woordes, appertaining to the mathematicalles.

The grounde is thought that steddye staye,  
Where no foote faileth that well was pyghte:  
Whereon who walketh by certaine waye,  
His pasc is lyke to prosper ryghte.

1. The Grounde of Artes who hathe well tredd,  
And noted well the slyppery slabbes,  
That may him force to slyde or falle,  
He hathe a staffe to staye withall.

2. Then if he trade that Pathwaye pure  
That vnto Knowledge leadeth sure:  
He maye be bolde tapproche The Gate

3. Of Knowledge and pasc in thereat.

Where if with Measure he doo well treat:

4. To Knowledges Castle he maye soone get.  
There if he trauaile and quainte him well.

5. The Treasure of Knowledge is his eche deale.

5. This Treasure though that some wold haue,

3. Whiche Measures friendshippe do not craue,

2. Nor walke the Pathe that leadeth the waye,

1. Nor in Artes grounde haue made their staye,

Thoughe bragge they maye, and get false fame,

4. In Knowledges courte thei neuer came.

## Certaine faultes omitted out of the corrections.

10.29, p100fe of my woordes. And in the meane reason to procede as I  
began: you must. 212.1, differeth not. In this table the fyfte. 279.17. defe-  
rentes. 280.28, within the shadowe. 281.15, in euery common almanach.  
283.21, alwaye runneth. 284.10. And the rather.



TO THE MOSTE MIGHTIE AND  
 MOST PVISSANT PRINCESSE MARYE, BY  
 the grace of God Queene of England, Spain,  
 bothe Sicilies, Fraunce, Ierusalem, and Irelande:  
 Defendour of the Faith: Archduchesse of Austria: Duchesse  
 of Millayne, Burgundye, and Brabant: Countesse of  
 Habspurge, Flayndres, and Tyrol, &c.



AS LOVE OF LEARNYNGE AND  
 zeale vnto knowledge (most dradde so-  
 ueraine Ladye) dyd prouoke me to at-  
 tempte an enterpryse farre aboue myne  
 habilitie, that is, to buylde a Castle for  
 knowledge to reste in, after hir longe  
 banishment & tediousse exyle. Although he  
 I could not be permitted by disturbaunce of cruell For-  
 tune, to accomplish now my buyldyng as I had drawen  
 the platte: yet in despite of Fortune, thus muche haue I  
 doone. Which is more then euer was done in this tonge  
 befoze, as farre as I can heare. But considering by mis-  
 fortune this Forste lacketh fence, and needeth som good  
 gouernoure to supplie that that wanteth, that know-  
 ledge maye reste vnder safe protection, I thought it my  
 duetye to make moste humble sute vnto your excellent  
 Maiestie, that it might please your highnes to accepte  
 this pooze Castle into your gracious tuition: that not  
 only in time of your Maiesties raign, but by your high-  
 nes speciall defence, knowledge myght bee maintained  
 and reuoked frō exyle. Vnto whiche sute I am the more  
 boldened, throughe remembraunce howe Godde in de-  
 spite of cancred malpce and of frowninge Fortune, dyd  
 exaulte your maiestie to that thzone royall, whiche of  
 iustice dyd belonge vnto your highnes, although the  
 misers of mischief wrought muche to the contrary. In  
 whiche matter as knowledge did detect the malpce of  
 other, and taught your true subiectes their duty to their  
 Scueraine, so knowledge yet diuers waies shall fur-  
 ther your Maiestie. And therefore am I encouraged to  
 a.ii. sue

due to your royall excellencie, not onely for to take into  
your highnes protection this Castle of knowledge, but  
all knowledges friends, which in hir mainenance do  
keepe continuall warre against pestilente Ignorance,  
the subuerter of Realmes: which knoweth no vertu, ho-  
nesty, nor duety, and therefore meaneth no truth, how  
to euer she flatter. yet doth she often tymes shewe great  
countenance of friendship, when she meaneth nothing  
lesse. Here coulde I paint forth Ignorance in hir right  
colours, but vnto your Maiestie it is needlesse, whome  
God not only hath endewed with excellent knowledge,  
but also hath ayded with such prudent Coucellars, that  
it maye seeme arrogancy in any suche as I am, to make  
explication, or in manner more then onely insinuation of  
anye doubtfull matters. It maye therefore please your  
Maiesty, for loue vnto knowledge, and fauour to your  
highnes subiectes, to accept this simple Castle into your  
graces defence, and so shall I bee animated to sy-  
mishe the rest, and to publish it vnder your Ma-  
iesties name. Whome God of his mercy in-  
crease in all honour royall, and true fe-  
licity, and continue prosperously  
and longe amongst vs.  
Amen.

Your Maiesties moste humble subiecte,

*Roberte Recorde Physicion.*

# INCLITISSIMO CARDINALI

POLO, CANTVARIENSI ARCHIEPISCOPO &c.

Reuerendissimo Archiepiscopo Eboracensi, Nico-

lao, summo Angliæ Cancellario. ac vniuerso sacrae

Regiæ Maiestatis Consiliariorum Præclarissimorum

Senatui, dominis maximè suspiciendis.



POLLOPHANES clarus ille sophista, qui in He-  
liopoli Aegypti ciuitate vna cū Dionysio Areo-  
pagita eo ipso tempore fortè degebat, quo Serua-  
tor hominum Christus crucis mortem sustinuit,  
quum admirandam illam eclipsim conspexisset,  
respōdisse dicitur: *Θέωυ ἀμοιβὰ πειγμάτων*. Dio-  
nysius verò altius quodāmodo adspirans, *ἢ τό θε-  
ου* (inquit) *πάσχει, ἢ τῷ πάσχοντι συμπάσχει*. Adeo cer-  
ta quidem ratio est coelestium motuum, vt si quid præter consuetum  
in cœlo eluceat, noui cuiusdam ac insoliti euentus indicium certis-  
simum esse conuincatur. Adde quod qua est benignitate Deus opti-  
mus maximusq̃, non vult homines inaduertentes opprimi, nisi eo-  
rum supina admodum inertia, aut cōtumax planè malitia diuinas eas  
admonitiones vecordius aspernetur. Erunt (inquit Christus) signa in  
Sole & Luna. diuinæ quidem in nos philanthropiæ certissima testi-  
monia, ac nostre, si neglexerimus, vesaniæ argumenta irrefragabilia. Si  
ingrati igitur in deum dici horreamus, præsertim in nostra ipsorum  
causa: imò si in ipsos nos iniuriæ esse, quod vitium naturæ aduersissi-  
mum censetur, nolimus, cœlum absidue contemplerur, diuinam in  
eo potentiam suspiciamus, prouidentiam admirantes amplectamur,  
sapientiam adoremus & exosculemur. siquidem dicente Propheta,  
*οἱ οὐρανοὶ διηγουῦνται δόξαν θεῶν*. atqui ne quis ad formam cœli, & motus  
tantum referat, *ἡμεῖς* (inquit) *τῇ ἡμετέρᾳ ἐρεῖ γὰρ τοῦ ῥήματος, καὶ νόϋ τῆ νοῦς  
ἀναγγέλλει γνώσιν*. Serenitatem itaq̃ vestram rogo, ac per pietatem ob-  
testor, per celsitudinis apices, honorumq̃ titulos, quos diuina fauen-  
te clementia adepti estis, obsecro: vt quod alij multi ex summa pru-  
dentia in vobis probant, id vos vicissim in alijs exoptetis. adq̃ ea  
studia alios, ingenua precipuè indole præditos, à vanis ludicrisq̃ ex-  
ercitijs, ne dicam improbis planeq̃ impijs, reuocetis. Penes celsitudi-  
nem excellentiasq̃ vestras est, subditorum studia moderari, exercitia  
prescribere, impetus effrenatos coercere. Vos oculi, aures, adeoq̃ mēs  
ipsa Regiæ Maiestatis estis. Vos regni sydera post solem ac lunam ip-  
sam splendidissima collucetis. Vos omnes probi tanquam patriæ pa-

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rentes

rentes, imò terrestres deos cernui adorant: vestris vestigijs aduoluntur: opem vestram nisi assidue senserint, actum planè de se iure optimo putant. At hæc studia fortassis quibusdam malè feriatis ingenijs parum reipublice commoda, eoq; vestro fauore aut subsidio indigna videri possunt. Aliter longe existimauit Atlas rex, qui inde sibi æternitatis nomen meruit, cælumq; humeris sustinere prædicatur, quod Astronomiæ studiosissimus, sydera obseruarit sedulo. Hunc Eusebius Enoch esse arbitratur. Hic inter Titanos præcipuus erat. quos si rectè intueamur, veneratione, nedum admiratione dignos censebimus: quod industria maxima altissimos montes scandentes, ibiq; in defessi pernoctantes, sydera obseruando, munia cuiusq; vera animaduertent, primi q; ostenderint ea vnius summi Dei imperio parere, nec deos esse: vanamq; gentiliū deorum opinionem arguerint. eoq; Iouem cælo deturbare conatos eos poëtæ asserunt. quo nomine quātum illis debeat syncerior religio, pī omnes agnoscūt. Liceret hic, nī longioris commemorationis tedium vitare, referre Orionem, Hyperionē, Endymionem lunæ amasium, Ganymedem, Adonim, Aeolum, Phaëtonem, & Ptolemæos, omnes principes viros, & astronomiæ studiosos, vt qui obseruationibus inuigilarint, motusq; syderum notarint. Alfonsi verò regis præclarissimi non vnquam inter mortuorum famam, ex hac arte multo celebriorem redditam, omnes norunt. Quin cessò artem omni laude maiorem amatoribus eius summis enīxius obtrudere: Hæc est illa maxima secundum Theologiam scientia, solo silentio prædicanda. Vestræ itaq; celsitudini tam eam quam alumnos eius omnes, precipue verò Recordum, supplex commendo. Deus vobis omnia fecunda donet, ex animi sententia.

Celsitudini excellentięq; vestræ deditissimus

*Robertus Recordus Medicus.*

# THE PREFACE TO THE READER.

*If reasons reachē transcendē the Skye,  
Why shoulde it then to earthe be bounde?  
The witte is wronged and leadde awrye,  
If mynde be married to the grounde.*

T H E R E F O R E,



W H E N S C I P I O B E H E L D E O F T H E  
of the high heauens the smallenes of the earth  
with the kingdomes in it, he coulde no lesse but  
esteeme the trauaile of men moste vaine, which  
sustaine so muchē grief with infinite daungers  
to get so small a corner of that lyttle balle. so  
that it yrked him (as he then declared) to considre the smalnes of  
that their kingdom, whiche men so muchē did magnifie. Who soe-  
uer therefore (by Scipions good admonishment) doth minde to a-  
uoide the name of vanitie, and wishe to attayne the name of a  
man, lette him contemne those trifelinge triumphes, and little e-  
steeme that little lumpe of claye: but rather looke vpwarde to the  
heauens, as nature hath taught him, and not like a beaste go po-  
ringe on the grounde, and lyke a scathen swine runne rootinge in  
the earthe. Yea let him think (as Plato with diuers other philoso-  
phers dyd trulye affirme) that for this intent were eies geuen vnto  
men, that they might with them beholde the heauens: whiche is the  
theatre of Goddes mightye power, and the chiefe spectakle of al  
his diuine workes. There are those visible creatures of God, by  
which many wise philosophers attained to the knowledg of his in-  
uisible power. There are those straunge constellations, by whiche  
Job doth prooue the mightye Maiestie and omnipotency of God.  
There are those pure creatures, whiche waxe not werye with la-  
boure, nother growe olde by continuance, but are as freshe nowe in  
beutye and shape, as the firste daye of their creation. and as apte  
nowe to perfourme their course, as they were the firste hower that

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they

they began. And though time wholly depend of it, yet time can not utter anye force in it. yea though all other thinges in the worlde by tyme be consumed, and euen the moste harde metals freted into drosse, yet the liquide heauens not only gouerne time it selfe, but utterly stande cleere from all corruption of time. Oh woorthy temple of Goddes magnificence: Oh throne of glorye and seate of the lorde: thy substaunce most pure what tonge can describe? thy beauty with starres so garnished and glyttering: thy motions so meruailous, thine influence strange, thy tokens so terrible, to stonish mennes hartes. thy signes are so wonderous, surmountinge mannes witte, the effects of thy motions so diuers in kinde: so harde for to searche, and worse for to fynde. Thy greatnes so huge, thy compassse so large, thy rolling so swifte, and yet seemeth slowe: thy staye so vnknown, thy place without name: thy spheres are mere wondres, and so is thy frame. Thy lyghtes are so lykinge to comforte mennes myndes, no beast is so brutishe, but that hee styll fyndes, thy warmenes to woorke him greate solace and ease: thy coloure to comforte his sight and his braine. Thy starres in suche ordre, thy circles so fine: thy platte forme is painted with manye a signe. Oh meruailous maker, oh God of good gouernaunce: thy woorkes are all wonderous, thy cunning vnknown: yet seedes of all knowledge in that booke are sown. The signes of the tymes who can them comprise? the tokens of troubles what man could deuise? And yet in that booke who rightly can reade, to all secrete knowledge it will him straighthe leade. The starre in the east dyd gouerne the Wisemen, and taughte them the very region where Christe should be borne. And farther by it they vnderstode, that he was the true kynge of Jewes, and sauour of Israell. And though manye sawe the starre as well as they; yet fewe or none knewe the signification but they. yet dyd God at the beginning ordeine the starres to be as signes and tokens of times alteration: and namely of suche straunge effectes as seldome come in vre, and therefore are known but to fewe men. These woorkes the more  
strange

# THE PREFACE.

strange they be, the more oughte men to esteeme the frute of them: to magnifie the knowledge of them, and to studie to vnderstande the mean to attaine them, but most of all to honour, praise and glorifie the author of them. who willeth nothinge to happen so suddenly on the moste wicked, but by som signes and tokens hee giueth warnyng of them. of which thing who so euer standeth in doubt, let him peruse the state of tymes, and hee shall see wonderouse things. Before the floude of Noe althoughe God did by speciall reuelation vtter his mynde to his seruante Noe, yet dyd hee also by wondrefull signes and straunge coniunctions, expresse the same to the whole world. for all the Planetes were in coniunction in waterye Signes. so that no nation might excuse them selues, for that they were so farre distaunte from Noe, that they could not heare his preachinge. sith all nations myght see the heauens and the tokens in it, althoughe but fewe in euery nation coulde skyll of them. And thoughe Noe coulde not in person go into all partes of the worlde, yet was that office supplied by the heauens, of whose resolutions it is written by Dauid the prophet: They haue no speach nor language, so that their voice can not bee hearde. yet did their course extende into all the earthe, and their wordes into the extreme boundes of the worlde. So was there neuer anye greate chaunge in the worlde, nother translations of Imperies, nother scarce anye falle of famous princes, no dearthe and penurye, no death and mortalitie, but GOD by the signes of heauen did premonishe men therof, to repent and beware betyme, if they had any grace. The examples ar infinite, and all histories so full of them, that I thinke it needeles to make any reherfall of them now: especially seeing thei appertain to the Iudicial part of Astronomy, rather then to this parte of the motions, yet shall it not bee preiudiciall anye waies; to repeate an example or twoe. As namelye before the buildinge of Rome, there was a verye notable eclipse of the Sonne, declaringe that the libertye of the worlde beganne then to decay, whē Rome began to rise: which shuld subdue all the

a.v.

worlde

T O T H E R E A D E R .

world neare hand: as in effect afterwarde it dyd succede, increa-  
singe styll by lytle and little, and continuynge for a longe tyme, tyll  
the Gothes in the time of *Arcadius* and *Honorius*, did spoile that  
citty, and subdue their power. At which time also straunge signes  
dyd appeare in the ayer, and in the skye: whiche seemed not onely  
to signifie the deuastation of the Imperye of Rome, but also the  
subduynge of all the weste prouinces, by straunge inuasion of bar-  
barous nations. Many other straunge eclipses both of Sonne and  
Moone, beside the appearing of sondrye Sonnes, and straunge  
shapes of the Moone, and the starres diuerselye disordered, with  
Rainbowes of meruailous formes, Cometes of diuers kindes, and  
other wonderfull signes, whiche euer were messengers of as won-  
derfull effectes, of newe innouations, straunge transmutations,  
and sometime vtter subuersions, not onely of small prouinces, but  
also of greate kingdomes, yea and of many regions at ones. And  
therefore sayth *M. Manilius*.

*Nunquam futilibus excanduit ignibus æther.*

The earthe doth euer feele grieffe and teene,

When those straunge syghtes in heauen be seene.

But who that can skyll of their natures, and coniecture rightlye  
the effect of them and their menacynges, shall be able not only to  
auoide many inconueniences, but also to atchiue many vnlikely at-  
temptes: and in conclusion be a gouernoure and rulare of the stars  
accordynge to that vulgare sentence gathered of *Ptoleme*:

*Sapiens dominabitur astris.*

The wise by prudence, and good skyll,

Maye rule the starres to serue his will.

I mynde not to discourse in declaringe the profite and commodity  
of *Astronomye*, but only to admonishe briesfly the reader, that hee  
maye thinke the study woorthye his trauaile, and to knowe it to be  
the moste necessary studye that can be, for anye man that desireth  
perfection of wisedome. What benefite doth come by it to the true  
knowledge of husbandrye and nauigation, I am assured the verye  
simplest in those artes do partlye perceauē: and the cunningest  
in

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in the same do so fullye vnderstande, that they iudge them selues naked and bare without it, and vtterlye destitute of all excellency in their arte. In physicke the vse of it is so large in iudginge due by of complexions, in prescribinge righte ordre of diete and conuersation, in gouernaunce of healtie, for iuste ministration of medicines in time of sickenes, and in righte iudgement of the Criticall daies, that without it physicke is to be accompted vtterlye imperfecte. For prooffe wherof althoughe there be infinite places in Hippocrates and Galene, and diuers other good writers, yet hee that hathe readde in Hippocrates but that one booke of *Ayer, water, and Regions*, and Galen his third booke of *Criticall daies*, can not be ignoraunte howe necessarye an instrument *Astronomy* is vnto *Physicke*, as bothe those bookes do testifie at large. But omittinge the testimonies of famous wryters (whiche would make a wonderfull volume of them selues, if they were written only together) I wyll vse a simple plaine prooffe manifest to all men, and therefore moste apte for to perswade all men. Firste to begin with sowinge of graine, with graffynge and plantinge, who is so rude, but knoweth that without these be dulye doone, and in their seasonable time, men can not conveniently lyue on the earthe? And howe are their times knowen, but by the risinge and settinge of certaine notable starres? Peraduenture some man will answer, that by the monethes of the yeare all men do know their times without farther *Astronomy*. whiche answer is suche, as if a carpentar or mason shoulde saye, that he can woerke with his compasse, rule, squire, plumb rule, and suche like instrumentes, without any knowledg in *Geometrye*. but how ridiculous an answer this were, all men can iudge. Likewaies, if a master of a shippe would say, that he can saile and gouerne his course by his compasse and his carde, with his quadrante and his other instrumentes, without any knowledge in *Cosmographie* or *Astronomye*, would not all men that heare him, deryde him, or thinke him madde, for speaking so vndiscreatly, especially such as know (as few ar ignorant therein)

that

TO THE READER.

that all those instrumentes are made by those artes, and appertain to them? So if the distinction of times do depende of Astronomy all together, and the monethes woulde soone runne out of their courses, if the ayde that it hathe by that arte were neglected, so that Michelmas day wold happen in the Spring time, and the Annunciation of our Ladye would fall after haruest (as the truthe is, it would do, if Astronomicall accompte were not) who can shew him selfe so madde as to denye the necessarye vse of Astronomye; in due keeping the times of the yeares? The ecclesiasticall historye dothe declare at large, and other writers in greate numbres do testifie, that greate controuersye hath beene in the churche, for the righte obseruation of Easter, whiche controuersye could neuer be decided but by the knowledge of Astronomye. And of late yeares in diuers councelles redresse hath beene sought for the iuste obseruation of it: consideringe that if error be in it, all other moueable feastes, are wrongly kepte by that occasion, and Lente displaced so, that some tyme it hath beene kepte sooner then it ought, and at other times later then it oughte. whiche faulte can neuer be redressed but by astronomy. Whereby it appeareth also manifestly, that in ecclesiasticall maters Astronomy hath a great vse. but that is so well knowen, that euerye man almoste doth confesse it. And generally who so euer dothe take benefite by the dewe distinction of the yeare, he can not chuse but acknowledge that the same commoditie doth come by Astronomy. If I should specially and particularlye discourse in euerye kinde of science and artes, and shewe how they are ayded by astronomye, I should make my preface ouer longe, and repeate thinges that all men doth knowe. In lawe for contractes and bargaines the time is moste necessarye to be obserued: but especiallye if they depende of moueable feastes, wherein astronomy must discusse the doubt. In Grammar, Logike and Rhetorike howe needefull it is, and in histories also, I neede say nothinge, but remitte all men to the readinge of those booke, which are vsed in those artes, whereby it shall appeare, that without the  
prin

THE PREFACE.

principles of *Astronomie* those bookes can not bee vnderstande. Then for vulgare artes how the knowledge of ebbes and fluddes doth profite, manye men, but specialllye mariners can testifie: and namely suche as vnderstande, what errour commeth by the difference of the true accompte therein and the vulgare accompte. Again for loppinge of trees and wodde fall, and diuers other obseruations in husbandry, the consideration of the sonne and commonlye of the moone doth greatly heape. Wherefore I maye conclude, that in all artes and sciences, in lawe, physicke and diuinitie, in mariners arte and husbandrye, the profite of *Astronomie* is exceeding necessarye. But aboue all other thinges the testimonye of Christe in the scripture doth most approue it, when he doothe declare that signes of his comming, and of other straunge effectes shall be seene in the Sonne, Moone and Starres. Also for alteration of weather he testified that many did marke the face of heauen, and pronounced truly of the weather, and therefore blameth them that thei coulde not marke and iudge the signes of the comming of the Sonne of man. But here possiblye some men will objecte the saynge of the propete: Feare not the signes of heauen. wherevnto I maye duelye answere: that those woordes of Hieremye do forbidde honouringe of them as goddes, as the texte is plaine. for oftentimes in the scriptures fear of God is taken for honoure of God, and so is it here. els other wayes might I answer that the true seruantes of God whiche haue reposed the loue and feare of God in their heartes, are neuer aserde of any tokens that God sendeth, but reioyce to see them, and glorifie God for them. But bicause in this case there be manye diuines that can better declare those thinges then I, whiche am a man of an other profession, I will remitte that matter to them. only admonishing all men, that the Sonne, the Moone and the Starres, were ordained of God to serue all nations that be vnder the heauens, as Moses dooth testifie. Then seyng God hath made them for mannes commoditye, and to be distincters of times, and for signes and tokens,  
for

TO THE READER.

for aide of mennes knowledge, let not men be vnkinde to God & gain, but lyfte vp their eies to heauen, and beholde the good giiftes of God: Note diligently their meruailous motions, and studioustlye conside their wondrefull alterations, with perpetuall constancie and inuiolable ordre: so shall men neuer bee doubtfull of Goddes prouidence towarde them, of his daylye prouision for them, when they see that he hath made suche an vnexplicable frame to serue onely for mannes vse, for whose sake all other creatures also were made. In token therfore of thankfulness, let vs singe an Hymne vnto that God, praisinge his name, and magnifynge him for euer and euer.

The worlde is wroughte righte wonderoustlye,  
whose partes exceede mennes phantasies:  
His maker yet moste meruailoustlye  
Surmounteth more all mennes deuise.

No eye hath seene, no eare hath hearde  
The leaste sparkes of his Maiestie:  
All thoughtes of hartes are fullye barde  
To comprehend his Deitye.

Oh Lorde who maye thy power knowe?  
What mynde can reache the to beholde?  
In heauen aboue, in earthe belowe  
His presence is, for so hee woulde.

His goodnes greate, so is his power,  
His wysedome equalle with them bothe:  
No wante of will sith euerye hower  
His grace to shewe he is not lothe.

Beholde his power in the skye,  
His wysedome echewhere dooth appeare:  
His goodnes dooth grace multiplie,  
In heauen, in earthe, bothe farre and neare.

FINIS.

THE FYRST TREATISE OF  
THE CASTLE OF KNOWLEDGE.

*Whiche is an induction to the necessary partes of the Sphere,  
as well celestiall as materiall.*

SCHOLLAR.



THE TIME SEMETH long (bee it neuer so shorte in deed) to hym that desirously looketh for any thing: for as the obtainig of it bringeth great pleasure, namelye the thinge it selfe being profitable, so the wante therof causeth displeasure and cōtinuall grief tyll the desire be eyther fully satisfied, other

*The desire  
of know-  
ledge.*

partly (at the least) accomplished.

Maister. And sometimes we see, that when the desire is partly perfourmed, and the pleasantnes of the same ones tasted of, the desire therby nothinge asswageth, but contrarye ways greatly increaseth: and the more it getteth, the more it desireth. so that in this point may knowledge well be cōpared to couetousnes: for as the couetous mynd with gettyng is neuer satisfied, so knowledge by knowing doth couet ityll more: And as it increaseth, so doth it still learne the vilenes of Ignorance, and profite of Sciences, and therefore can not rest from searhing more knowledge, as long as it spyeth any spot of ignorance.

Schollar. This oftentimes as I haue considered, maketh me to muse what mynd is in them, which care for no knowledge, nor esteeme any science.

*The grosse-  
nes of i-  
gnorance.*

Maister. This is the greatest pointe of all ignorance, not

A.i.

to

to know the grossenes of ignorance, and not to vnderstand the benefite of knowledge, and with this fault are a greate nombre spotted. The nexte is their faulte, whiche perceaue sufficientlye what vilenes is in ignorance, and what profite in knowledge, and yet of a certaine negligence partelye, and partlye for other pleasures, they omytte to trauayle anye whitte for knowledge, and contente them selues wyth wilfull ignoraunce: but as these men do trouble the good state of the worlde, so the talke of them wyll hynder the talke of the worldes knowledge, whiche is the thinge that you so muche longe after: and therefore beste it is, that wee let them lye still tomlinge in the dyche of ignoraunce, and that wee trauaile forward towarde the Castle of knowledge. But first let me heare what is your chief desire.

The occasi-  
on of this  
booke.

Schollar. Syth my laste talke with you aboute the knowledge of the worlde and the partes of it, I haue readd dyuers bookes that intreate of that matter, as namelye Proclus sphere, Ioannes de Sacro bosco, Orontius cosmographye, and diuers other, whose woordes in manye thinges I remembre, but of the matter I haue sondry doubttes, and therefore desire muche your healpe therein. For althoughe I haue consulted with diuers men therein, yet me thynketh they tell me but the same woordes in lyke sorte as I readde theym before, or lyttle other wayes altered, but lyghte of vnderstandynge, I haue gotten lyttle yet.

Master. Then proue againe, peraduenture your chaunce may be better: that whiche at the fyrste semeth harde, maye at lengthe become easy: for Vse maketh masterye, all men confesse. And, The best thynges are not mooste easiest to attayne. begynne in that ordre as youre Authours doo.

The diuersi-  
tye of  
writers.

Scholar. Theyr ordres bee as dyuers as theyr names be, so that I knowe not whose ordre is best. For Proclus in treatinge of the Sphere, defineth firste the Axe tree of the

the worlde, before hee had shewed other what the worlde is, or what hee calleth a Sphere, or what neede the worlde hathe of anie Axe tree. Therefore I tourned to Ioannes de Sacro bosco our contry man, whiche beginneth firste with the definition of a sphere, but nothinge lyke to that sphere, whiche I before had bought, as an apt instrument to learne by. Then see I Orontius disagree from them bothe; and generallie, euerye one from other, so that I know not wher to beginne.

Master. As touchynge those writers, I will saye no more nowe, but although euerye one of them haue some thinges that exactlie scanned may be misliked, yet he that hath doone worste, is woorthie of thanks, for his studious paines in furtheringe of knowledge. And seying you doubt of their ordre, lette the thinge it selfe minister ordre. What is it that you desire to knowe?

Scholar. I see in the heauen meruailous motions, and in the reste of the worlde straunge transmutations, and therefore desire muche to know what the worlde is, and what are the principall partes of it, and also how all these straung sightes doo come.

The argu-  
ment of  
this booke.

Maister. Then is the worlde the thinge that you woulde knowe first, syth all these other thinges are incident to it. What doo your authors call the Worlde?

Scholar. Orontius defineth the worlde to be the perfect and entiere composition of all thinges: a diuine worke, infinite and wonderfull, adorned with all kindes and formes of bodies, that nature coulde make.

what the  
worlde is.

Master. This definition doth muche agree with those that bee writen by aunciente authors, and namely Aristotle whiche defineth it thus.

κόσμος ἐστὶ σύνθεσις ἐξ οὐρανοῦ καὶ γῆς, καὶ τῶν ἐν τούτοις περιχουμένων φύσεων.

Mundus est compages ex coelo & terra, & reliquis in iisdem contentis naturis.

A.ij.

The

wherof the  
worlde is  
named.

The worlde is an apte frame of heauen and earthe, and all other naturall thinges contained in them. The like wordes hath Cleomedes and others. So that the worlde is that entiere body, whiche containeth all thinges that euer God made, and man can see, nothinge excepted but God himself only, whiche is not comprehensible by any worldly meanes. This worke is so pure and wonderfull in beauty, that it beareth the name of cleannes, bothe in Greke and Latine, that is κόσμος in Greeke, and Mundus in Latine. and thereto alludeth Sibyll in her verses, speakinge of the dissolution of the worlde, saying:

ἔσται κόσμος ἄκωσμος ἀπομυμνίων ἀνθρώπων.

Erit mundus immundus, pereuntibus hominibus. The worlde (saith she) shalbe vnclean, or leese his beuty, whē all mē shal perishe.

Schollar. And so dooth that sentence leese his beautye by the translation, for there canne bee no suche allusion of woordes in the englyshe of that sentence, as there is in the other tongues.

Diuers si-  
gnificatiōs  
of that  
worde  
worlde.

Master. You say truthe, except a man wold rather allude at the woordes, then expresse the sentence, for so might it be translated thus: It shall bee an vnworldlye worlde, when all men shall perishe: But here the sense is loste: for this name Worlde, hath not the like deriuation of cleannes in englysh, as the Latine and Greeke names haue in their tongues: nother can I well tell wherof this englyshe name is deriued, although I remembre som other significations of this worde, as firste it is vsed in Scripture for a name of long continuance of tyme, when we say: Worlde without ende. and, thorough worlde of worldes: whiche signifieth for euer. Also this name dooth signifye sometymes a greate wonder, as when wee saye: It is a worlde to see the crafte that some menne vse vnder colour of simplicitye. Nowe if anye man wyll contende, that this worde Worlde dooth principallye betoken a wonder, and that the worlde for the wonderfull shape of it, tooke that name, as the chieffe wonder

der of all wonders, I will not greatlye repine, but then muste I needes wonder, to see the chieffe worldely men to wonder so lyttle at this wonderfull wonder, and to bend all theyr studye to the centre of the worlde, I meane the Earthe, whiche in comparison to the whole worlde is not onlye a parte without all notable quantitye, but also leaste adourned with meruailous woorkes, and moſte ſubiecte to all frayle transmutation and chaunge, ſtyll replenished with continuall corruption. And yet on it only doth the greateſt numbere ſet all their studye. For it they ſuſtaine greate trauaile and toyle: for yt they chide, quarrell and fyghte: to gette it they venter lyfe and lymme, and when they thynke moſte aſſuredlye that they haue gotten the Earthe, then in deede the earthe hath gotten them, and moſte commonlye then doothe the earthe conſume them, when they thinke theym ſelues fulle maiſters of yt.

Schollar. By theſe mennes trauaile (I thynke) it came to paſſe, that the earthe doothe vſurpe the name of the Worlde; as though it were all, and that beſides it were nothinge.

Maſter. Thereof commeth that common Prouerbe of a couetous manne: All the worlde is to lyttle for him. where he in deede ſeeketh nothyng but the earthe, whiche earthe in comparison to the whole worlde beareth no greater vewe, then a muſtarde corne on Malborne hylles; or a droppe of water in the Ocean ſea. for of all the partes of the worlde, the earthe is the leaſte, and that withoute comparison, as hereafter I ſhall not onlye tell you, but alſo prooue it by inuincible reaſon. And therefore to proceede in oure matter, I thynke it beſte not onlye to make diſcourſe lyghtlye of the principall partes of the worlde, but to dooe it in ſuche a brief ſorte, as the mynde maye conceaue it ſooneſt, and the memorye alſo retaine it longeſt: and therefore will I omitte

*The ſmalenes of the earthe to the whole worlde.*

*The beſt ordre in teachinge.*

all proofes, tyll we haue ones generally drawen the ymage of the whole worlde, so shall not your memory be troubled with fundrye thinges at ones, as in learnyng a science whiche seemeth sumthing straunge, and in conceauyng the reasons of it, whiche in declaring, seeme much more straunge.

Scholar. In deed I haue felt the discommoditie of suche hasty desires: for where I haue sought reason, before I vnderstoode, whereto that reason tended, I haue troubled my mynde, and hyndred my knowledge. wherefore it may please you in your ordre to procede.

*The ordre  
of the ele-  
mentes.*

Master. I haue all ready sayd, that of all the partes of the worlde the Earthe is the leaste: wherby you may conceaue, that within it is nothyng: for so should that (what so euer it were) be lesser then the earthe. but without the earthe, dooth the Water lye, whiche couereth a greate parte of the same: about them bothe, dooth the Ayer run, and occupieth (as we maye easilye consider) muche more roome, then bothe the sea and the londe: aboue the ayer, and rounde about it, (after the agreement of moste wise men) dooth the Fyer occupye his place. And these foure, that is, earth, water ayer and fyer, are named the foure elementes, that is to say, the fyrste, symple and originall matters, whereof all myxt and compounde bodies be made, and into whiche all shall tourne againe.

*All thinges  
compounde  
ar made of  
the foure  
elementes.*

Scholar. Oftentimes haue I heard it, that bothe man and beastes are made of earthe, and into earthe shall retourne againe: but I thought not that they had been made of water, and muche lesse of ayer or fyer.

Master. Of earthe only, nothyng is made but earthe: for an herbe or tree can not growe (as all men confesse) excepte it be helped and nourished with ayer conuenient, and due wateringe, and also haue the heat of the Son, and generally, syth all thyng is maintained by his lyke, and is destroyed by his contrarye, than if man can not be maintained without fyer, ayer and water, it must needes appeare, that

that he is made of them, as well as of earthe, and so likewise all other thinges that be compounde.

Scholar. This talke delyteth me meruailously, so that I can not bee wearye of it, as longe as it shall please you to continue it.

Maister. This talke is not for this place, partly for that it is more physycall then astronomicall: and partly bicause I determined in this firste parte, to omitt the causes and reasons of all thinges, and brieflie to declare the partes of the worlde, whereof these foure elementes, beinge vncompounde of them selfe, that is simple and vnmixt, are accōpted as one parte of the worlde, whiche therfore is called the Elementarie parte, and bicause those elementes do daile in crease and decrease in some partes of them (though not in all partes at ones) and are subiecte to continuall corruptiō, thei are distinct from the rest of the worlde, which hath no suche alteration nor corruption, whiche parte is aboue all the foure elementes, and compasseth them about, and is called the Skie, or Welkin, & also the Heauens: this part hath in it diuers lesser or special parts, named cōmonly Spheres: as the sphere of the Moone which is lowest, and nexte vnto the elementes: then aboue it, the sphere of Mercury: and nexte to it the sphere of Venus: then foloweth the Sonne, with his sphere: and then Mars in his ordre: aboue him, is Iupiter: and aboue him, is Saturne. These seuen, are named the seuen Planetes, euery one hauinge his sphere by himselfe seuerallie, and his motion also seuerall, and vnlike in time to anie other. But aboue these seuen planetes, is there an other heauen or skie, whiche commonly is named the Firmament, and hath in it an infinite numbere of starres, wherof it is called the Starrye skie. and bicause it is the eighte in ordre of 8 heauens or spheres, it is named also the Eight sphere. This heauen is manifest inough to all mennes eies, so that no man needeth to doubte of it, for it is that skie, wherein are all those starres that we see, except the fīue lesser planets,

A.iiij.

whiche

The elemētes are simple.

The elemētes do alter daile in their parts.

The skie.

The ordre of the spheres.

The seuen Planetes.

whiche I dyd name before, that is Saturnus, Iupiter, Mars, Venus and Mēcurye.

Schollar. The Sonne and Moone also must bee excepte oute of that numbre, for they haue their spheres by them selues, as well as the other Planetes.

Howe the  
Planets are  
known  
from other  
starres.

Master. Truthe it is, but bicause no man dooth accompte them as starres, therefore they neede none exception, where mention is made of starres onely, where as the other fve smaller Planets (whiche I named before) are so like to other starres, that no manne, but suche as are of good experience in Astronomy, can discerne them from the other starres, although manye men doo make a difference of them by twinkeling, affirming that the Fixed starres doo twinkle, and not the Planetes, with other differēces difficult to obserue, and scarce certeine in distinction. But this is their moste certaine difference, that all those starres, whiche be in the firmament, do stande and continue in one forme of distaunce eche from other, and chaunge not their places in their spere, and therefore be they called Fixed starres: for althoughe thei go rounde aboute the worlde in 24. houres, that is euerye day ones, yet they keepe their places in their sphere, and tourne onely with their sphere: or (as Aratus sayth) thei be drawen with their heauen, wher as the feuen Planetes are not only carried round about the earthe with the like motiō of heauen euery day, but they do moue of them selues, and doo chaunge their places in their owne spheres, and for that cause are they called Planetes, that is to say, Wanderynge starres.

Scholar. Oftentimes haue I hearde this, but yet can I not tell howe to perceauie it.

Maister. That shall be referred to the fourth treatise, wher I wyll shewe yow the prooffe of all that you shall thinke doubtfull.

Scholar. Yet I beseeche you lette me knowe this, Whye are those heauens called Spheres? for (in my phantasie) they

they are nothinge like that instrument of fundrye cirkles, whiche is commonly called the Sphere, syth neither can I se in them suche cyrkles as are in that materiall sphere: nother is there in the materiall sphere anye suche representation of suche dyuers heauens; nother of suche varietie of starres.

Maister. This doubt was moued before nowe, by Ioachim Ringelbergh, in a treatise that he wrote of the Sphere, but it shall be answered easily by your selfe, after a lyttle declaration of the celestiaall spheres. And for that cause, I wyll omitte it tyll anone, and will firste declare certayne other accidentes of the heauens; and of the other partes of the worlde.

Hitherto you haue hearde onely the names of the partes of the worlde, and of their situation, howe they be placed in ordre. Nowe for the forme and shape of them, you shall vnderstande, that the whole worlde is rounde exact-lye as anye ball or globe, and so are all the principall partes of it; euerye sphere seuerallye and ioyntlye, as well of the Planetes, as of the Fixed starres, and so are all the foure Elementes. And they are aptely placed together, not as a

*The forme  
of the  
world and  
his partes.*



deth other, as they be in ordre of greatnes, beginning at the eighte sphere or firmamente, and so descending to the laste and lowest sphere, is the Sphere of the Mone: vnder which the foure elementes succede: first the fier, then the ayer: nexte foloweth the water: which with the earth

ioyntlye

ioyntlie annexed, maketh as it were, one sphere only.

Scholar. This I do well vnderstande in wordes, and the easier by this picture, whiche I finde in euerie booke of the Sphere, but that I see there more spheres, then you speake of: for in some bookes mention is made of nyne spheres: and in other are ten spheres named, where you sette foorth but eighte.

*The earthe  
is the cētre  
of the  
worlde.*

*The earthe  
hath no  
quantity in  
respekte to  
the world.*

Master. The cause of this diuersitie will I in the fourthe treatise declare: in the meane season, I thinke it best to tell you of no mo spheres, then are perceptible by sighte, for so manye are we certaine of. And therefore vnderstande you thus, that as the eighthe sphere is the greatest, and hath none other without him that maye be seene, so the earthe is the leaste, and hath none other within hym, but it standeth in the middle and in the centre of the whole worlde, and of euery one of these spheres, and therefore it is called the Centre of the worlde: so that although the earthe in it selfe haue a greate and notable quantity, yet in comparison to the firmament, it is to bee esteemed but as a centre or little pricke, yea in deed muche lesse than any notable starre that you see, & if I shall speak boldly that which I intend herafter to proue certainly, the earthe is lesser then the leaste starre in the firmament whiche is commonly seen, but yet is it greater then Venus or Mercury, yea greater then the Moone.

Schollar. This affirmation seemeth to me impossible, or at the least contrary to sence: for the Moone seemeth bygger muche then any starre, yea somewhat bigger then the Sonne.

*The earthe  
hath no  
motion.*

Master. Content your selfe to credite me, tyll tyme serue for the proof of my woordes, and in the meane season, to procede as I began. You must thinke, that the earth and the water annexed together in one globe, are of no notable quantitye, in comparison to the firmament, and that it standeth as the centre of the worlde, and hath no motion out of his place, nother yet circular mouyng about his owne centre, but resteth (as we may say) quiete without all such mouyng,

uynge. Lyke wayes must you thinke of the other elementes, whiche of their owne nature haue none other motion then a stone or a lyghte fether, so that they may be accompted all four to be without naturall motion.

Scholar. Yet in the water and in the ayer we see euerye day notable mouynge. and sometime I haue hearde of mouynge of the earthe, by earthquakes: and as for the fyer that we see, it alwaies moueth and flyckereth in burninge.

Master. And so you haue seene a stone moue swiftelye, when it fell from anye hyghe place. but these motions haue an ende quicklye, excepte they be continued with violence, as hereafter I will sufficiently declare. But as the stone although it wyll moue in fallinge, yet in his place lyeth quiete without motion: so the earthe of it selfe, and the other elementes muste be accompted quyete by nature, and without motion.

¶ The heauens contrarye wayes haue suche a naturall motion that neuer resteth nyghte nor daye, nother can be staied by any violence. This motion wee se in the heauens daylye by their mouinge from the easte to the weste, and from the weste to the easte againe, aboute the earthe, ones euerye 24. howers, and therefore is thys motion named the Daily motion, for it is the measure of a Naturall day, commonly accompted. and this motion is lykewayes called of aunciente writers the motion of the First firmament, accordynge to whiche motion you see the Sonne in the daye tyme, and the starres in the nyghte tyme, and the Moone both in the day and the nyghte, to passe from the easte into the southe, and so into the weste, and at the ende of 24. houres to come againe into the easte: wherby you may easily vnderstand, that this motion is common to all the spherēs of heauen.

Scholar. This maye all men see, that can see any thing. yet haue I heard of some so grossely witted, that they doubted which way the Son and the Moone dyd come into the east agayne, as though they did not thinke that the skye dydde moue

*The motions of the heauens.*

*A Daye.*

move about the earth.

Master. Suche grosse ignorance happened somtymes to famous men, for lacke of due consideration of that, whiche all men maye see, as I will in place conueniente more largelye note.

*A diuers  
motion in  
the Moone.*

Schollar. Yet one doubt I haue, of whiche I wolde gladly be rydde, and that is of the Moone: for as you saye, and by syghte wee perceaue, all the starres with the Sonne and Moone go round about the earth in 24. houres, saue that the Moone is slacker then all the rest, for she is euerye daye later in rysynge by an hower, then she was the daye before: but howe that cometh to passe, I doo not vnderstande.

*A feuerall  
mouing in  
the Sonne.*

Ma. This doubt is well moued, and in good tyme, for by it will I take occasion to instruct you not only in the true knowledge of it, but also of other sondrye motions in all the heauens: for in euery one of them dooth there appeare a lyke motion, contrarye to the daile mouinge of the Firmament, whiche in the Moone is mooste swiftest, and therefore may be perceaued daylye of all men: but in the Sonne it is not so swifte, and therfore not so easilye perceaued: yet all men see a greate alteration in the mouynge of the Sonne in one yeare: for somtymes he is hygher and nearer ouer our headdes, and sometime farther from our headdes, and lower in the southe: yea sometime he shineth with vs almooste 18. howers, (as in the middle of the Sommer) and in the middle of Winter hee shineth but 6. houres or lyttle more: this euerye childe dooth see, althoughe they knowe not the reason thereof.

Scholar. Yet the reason of that is easy inough to be conceaued, for when the daye is at the longest, the Sonne muste needes shine the more tyme, and so must it needes shine the lesser tyme, when the day is at the shortest: this reason I haue hearde many men declare.

Master. That may well be called a crabbed reason, for it goeth backward lyke a crabbe. The day maketh not the son  
to

to shyne, but the Sonne shynynge maketh the daye. And so the lengthe of the daye maketh not the Sonne to shine longe, nother the shortenes of the day causeth not the Sonne to shyne the lesser tyme, but contrarye waies the longe shynynge of the Sonne maketh the longe daye, and the shorte shynynge of the sonne maketh the lesser daye: els answere me, what maketh the dayes longe or shorte?

Schollar. I haue heard wise men say, that Sommer maketh the longe dayes, and Wynter maketh the longe nyghtes.

Master. They myghte haue sayde more wiselye, that long dayes make sommer, and shorte dayes make winter.

Schollar. Why, all that seemeth one thing to me.

Maister. Is it all one to say? God made the earth. and the earth made God? Couetousnes ouercometh all men. and all men overcome couetousnes.

Schollar. No not so, for heere the effecte is tourned to bee the cause, and the agente is made the paciente.

Master. So is it to saye; Sommer maketh longe dayes, where you shoulde saye: Longe dayes make sommer.

Schollar. I perceauie it nowe, but I was so blynded with the volgare erreure, that if you hadde demaunded of me farther what dydde make the Sommer, I hadde bene lyke to haue aunswered, that greene leaues doo make Sommer: and the sooner by remembraunce of an olde sayinge: that a yeare shoulde come, in whiche the Sommer shoulde not bee knowne, but by the greene leaues.

Master. Yet this sayinge dooth not importe that greene leaues do make sommer, but they betoken sommer: so are they the signe and not the cause of sommer.

Schollar. So I perceauie nowe that the longe shynynge of the Sonne doth make the dayes longe. But nowe can I not tell what causeth the Sonne to shine longer one tyme of the yeare, then an other.

Master. That is it that draue wise menne to searche, and

A yeare.

A moneth.

A weeke.

marke the motions of the Sonne, whereby at lengthe they founde, that the Sonne hathe an other course, contrarye to the daylye motion of the skye. And as the Moone doth accomplyshe her propre course (whiche is from the west into the easte, contrarye to the daylye motion) euerye moneth in the yeare, so the Sonne dothe ende his course, in his propre motion, but ones in the yeare. And to expresse it aptlye, I muste saye, that the true terme of a yeare is nothyng els, but the verye tyme of the course of the Sonne from a certaine pointe in heauen; tyll his retourne to the same pointe againe. And a Moneth is the iuste time of the propre course of the Moone, from chaunge to chaunge: and euerye quarter of the Moone maketh a Weeke. of whiche I will speake more in the nexte treatise, with the declaration of the diuersitye for the begynninge of Monethes and Yeares. But nowe to contynewe oure principall matter the more ordrellye, I woulde haue you repeate the chieffe articles of our talke hitherto.

The fyrste  
repetition.

Schollar. This is the summe of all your doctrine hitherto.

1. That the worlde is that entiere body, which containeth in it all the heauens and the elements, with all that in them is.
2. The partes of the world ar two especial, the heauens whiche are eighte in numbre, and the elements whiche are.iiij. in kinde.
3. The ordre and situation of all these partes, as well elementes as heauenly spheres, beginning at the highest, and proceeding to the lowest, is this. the Firmanent, Saturne, Iupiter, Mars, the Sonne, Venus, Mercury, and the Moone.

#### THE FOURE ELEMENTES.

Fyer, Ayer, Water, and Earthe.  
and euer the hygher incloseth all that is vnder it.

- 4 The worlde and all his principall partes are rounde in fourme and shape, as a globe or ball.

5. The

5. The earthe is in the middle of the worlde, as the centre of it: & beareth no vewe of quātitye in cōparison to the worlde.

6. The earthe hath no motion of it selfe, no more then a stone, but resteth quietly: and so the other elementes do, except they be forceably moued.

7. The heauens do moue continually from the easte to the west, and that motiō is called, The dayly motion: and is the measure of the Common day.

8. The Moone hath a feuerall motion from the west toward the easte, contrarye to that mouyng of the dailye course, and that motion is þ̄ iust measure of a moneth, and euery quarter dooth make a weeke.

9. The Son also hath a peculier motion from the west toward the easte, whiche he accomplisheth in a yeare, and of that course the yeare taketh his measure and quantitye.

Now then it may please you to procede to farther explication of the apparaunces which are noted in the heauens, and to shew the manner of their motions.

Master. To the intent that you may vnderstand all thinges the more easilye, I thinke it good to describe vnto you a Materiall sphere, whiche shall containe in it suche notable cyrcles only, as haue speciall vse in the declaration of the heauenly motions, and suche as reason shall driue a man to appointe, as certaine boundes of the motions in the heauens: yea suche I saye, as your selfe shall by interrogatories be constrayned to confesse needfull to that knowledg which you desire.

*A materi-  
all sphere.*

Schollar. If nothinge bee placed in that sphere but that which must needes be had, then can I not accompt any part of it superfluous. And againe, if it serue sufficiently to instructe me in that I desyre to knowe, I canne not iustlye blame it in anye pointe as insufficiente, so muste it needes be a perfect instrument, voyde of defaulte, and without superfluitye.

Master. So shall it be, for so muche as this parte of know-  
ledge

ledge requireth. Now then to begin. ye doo beleue that the worlde is rounde. Schollar. Yea for sooth.

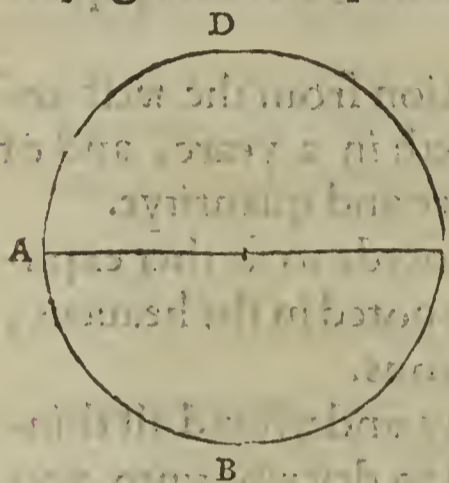
*The making  
of a Globe.*

Master. Then must that instrument also be round, which shall aptely expresse the forme of the worlde.

Schol. Truth it is. Mast. Can there be any thinge more round then a circle? Schollar. No trulye.

Maister. And dooth not twoo halfe cyrcles make a whole circle? Schollar. It can not be denyed.

Master. Then take halfe a circle, and fasten it on an axtre or on any diameter, and then tourne it rounde about, fyrste lettynge the halfe cyrcle hang downward vnder the diameter



as heere

you se it

figured,

in þ halfe

cirke, A

B, C. the

tourne þ

half cyr-

cle right

vp ouer the diameter, as here also

is represented in the halfe cyrcle

A, D, C. do not these two positi-

ons make a whole cyrcle? Scholar. Yes surely.

Master. Then set the halfe circle so, that the diameter may

stande styll firmelye fixed, and the halfe cyrcle maye tourne

rounde about. Do not you imagin nowe that euery dyuers

position of this halfe cyrcle with the contrary place against

it, dooth make a whole cyrcle? Schollar. Yes verelye.

Master. And bycause there is no place rounde aboute that

diameter, within the reache of that halfe circle, but that half

circle hath passed it, there can no voyde place be assigned

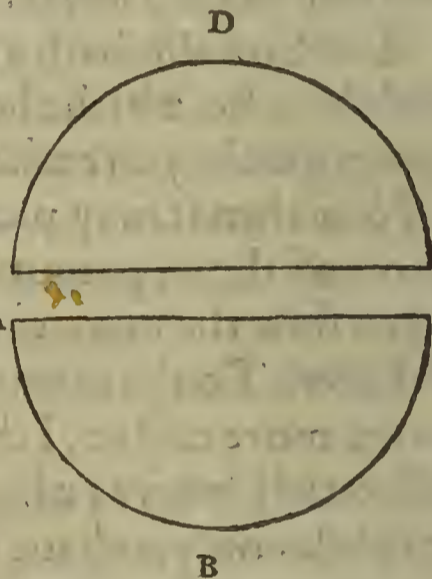
but it is occupied and fylled with halfe a cyrcle, and euerye

halfe cyrcle with his contrarye dooth make a whole cyrcle,

so doth this whole reuolution of the halfe circle make a iust

cyrcular bodye.

Scho-



Here is the lyke fourme  
of that worke.



Schollar. So it appeareth trulye.

Maister. This circular body is na-  
med a sphere, as it may appeare by the  
description that Euclide maketh of a  
sphere: whiche is this in greeke, as him  
selfe wrote it, in his eleuenth booke of  
Geometrye.

Σφαῖρά ἐστιν ὅταν ἡμικυκλίου μενούσης πῖσ διαμέ-  
τρον, περιγεχθῇ τὸ ἡμικύκλιον εἰς τὸ αὐτὸ πάλιν  
ἀπ' ἑαυτῆς, ὅθεν ἡρξάτο φέρεσθαι, τὸ περιληφθῆναι χῆμα

Whiche into Latine may well be translated thus.

Sphæra est figura comprehensa ex circumductu semicirculi, donec eò redeat,  
vnde moueri incœpit, manente interim immota semicirculi eius diametro.

And thus it foundeth in englishe.

A Sphere is a sound figure, made by the tournynge of half  
a circle, tyll it ende where it began to be moued, the diameter  
of that halfe circle continuynge steddye all the meane whyle.  
This description dooeth Ioannes de Sacro bosco expounde  
thus: that a sphere is a rounde and sound body made by the  
tournynge of halfe a circle.

Schollar. So that a sphere is nothinge els but a rounde  
and massye bodye closed with one plat forme, whiche you in  
your Pathwaye doo call a Globe.

Master. You take it ryghte. But nowe must you marke,  
that as a circle is made about his centre, so a globe also hath  
his centre, as you may easilye vnderstande, from which cen-  
ter all the lynes that may be drawen to the plat forme, or vt-  
ter parte of the globe, are all equall togiether, accordyng to  
Theodosius definition, whiche saythe thus: A sphere is a  
massye bodye, inclosed with one plat forme, and in the mid-  
dle of it there is a pricke, from which all lynes drawen to the  
sayde plat forme, are equall eche to other, and that pricke is  
the centre of the globe. and so sayth Euclide also.

The centre  
of a Globe  
or Sphere.

Κέντρον δὲ τῆς σφαῖρας ἐστὶ τὸ αὐτὸ, ὃ καὶ τοῦ ἡμικυκλίου.

Idem centrum sphæræ est, quod & semicirculi.

B. iij.

The

The centre of a globe is the same centre that ~~the~~ semicircle hath, by whiche the globe was made.

Schollar. It muste needes bee so: and lykewaies the diameter of them bothe muste needes be all one, as I thynke.

A Diameter  
and an  
Axe tree  
differ.

Maister. You saye not muche amysse. Yet must you put a difference in a globe, betwene a Diameter and an Axe tree. For euery right lyne that passeth frō side to syde in a globe, and toucheth the centre, is aptely called a diameter. so that as ther may be many diameters in a cyrkle, so may ther be as many also in a Globe: But of all that multitude, one only is called the Axe tree, and that is it on whiche the globe tourneth. This difference did Ioannes de Sacro bosco ouerpasse not ignorantly, but negligently, or els wittingly: but so dyd not Euclide, whiche defineth them bothe thus.

An axe tre

ἄξων δὲ τῆς σφαίρας ἐστὶν ἡ μόνουσα ἐνθεῖα, περὶ ἣν τὸ ἡμικύκλιον σφίρειται.  
Axis Sphaerae est, recta illa stabilis linea, circa quam semicirculus rotatur.

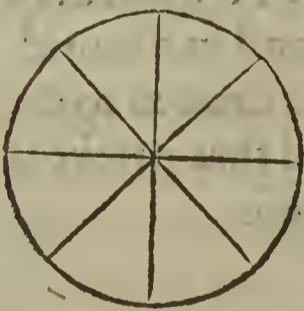


The Axe tree (saith he) is that righte lyne whiche moueth not, but the halfe circkle moueth aboute it. These wordes haue respect not only to the makynge of a Globe or Sphere, but also to the vse of it. But now the diameter is defined by him thus:

A diameter

διὰ μέτρον δὲ τῆς σφαίρας ἐστὶν ὕψευς τις ἀπὸ τοῦ κέντρου ἡγμένη, καὶ περὰ τοῦ κέντρου ἐφ' ἑκάτερα τὰ μέρη, ἕως τῆς ἐπιφανείας τῆς σφαίρας.

Dimetiens vero Sphaerae est recta quaeq; linea per centrum acta, & vtrunque desinens in sphaerae superficie.



The diameter of a Sphere, is anye ryghte lyne that is drawn by the centre, and ended in the plat forme of the sphere.

Schollar. This difference muste needes seeme reasonable, syth there maye be so many diameters drawn as a man lysteth, but

Axe trees there can be but one in one globe.

Ma-

Maister. When a globe tourneth rounde, are there anye mo poyntes then twoo in that globe, on whiche it doothe tourne?

Schollar. By proof it appeareth, that all partes of the globe moue, excepte the two endes of that Axe tree, wher on it mooueth, and they mooue not out of their place.

Master. Those twoo pointes are named the poles in a sphere, wherby also you may vnderstande, that there can be but two poles in one sphere: marke this well, for it will serue your turne in place conueniente. Nowe applye all these to the worlde, whiche in his whole substaunce is rounde, and therefore aptelye maye bee called a sphere: yow see it tourne aboute rounde, and therefore must it haue twoo poles, on whiche it tourneth so. Also bicause it is rounde, it muste haue a centre (whiche I dyd affirme before to bee the earthe) and by this centre, we may imagine a right line to run from the one pole to the other, whiche righte lyne muste be called the Axe tre of the worlde.

*Poles of a  
Sphere.*

Schollar. For the centre of the worlde, it muste needes be somthinge: for I perceauie a globe can not be, but it must necessarily haue a middle pricke or centre, no more then a lyne maye be made whiche hath no myddell, or a circle that hath no centre: whiche bothe appeare vnpossible. Also for the pooles, they appeare needefull, or rather of necessity to folowe the mouinges of heauen. For in all rounde thinges that mooue roundly, there be suche two pointes that seeme not to moue: but why there shoulde be any axe tree requyred in the worlde, I see no reason: for if the myghtye power of God dyd not staye the worlde, there coulde bee no Axe tree able to beare it.

Master. Your imagination in this pointe is to grosse. I sayde not that the Axe tre was made to stay the worlde, but that it passeth as a lyne only from the one pole to the other: and is not without greate and profitable vse, bothe in doctrine, and also in practise, for placynge of instruments, as

B.iiij.

you

you shall know better hereafter. But nowe heare howe Proclus dooth applye these to the worlde.

ἄξων καλεῖται τοῦ κόσμου ἡ διάμετρος αὐτοῦ, περὶ ἧς σφίγεται. τὰ δὲ πέρατα τοῦ ἄξωνος πόλοι λέγονται τοῦ κόσμου. τῶν δὲ πόλων, ὁ μὲν λέγεται ὁρίσος ὁ δὲ νότος.

Whiche wordes our worthye contrye man D. Linaker, translateth thus.

Axis mundi vocatur dimetiens ipsius, circa quam voluitur. Axis extrema, poli mundi (seu vertexes) sunt nominati: horum alter Septentrionalis, alter Austrinus dicitur.

The north  
and southe  
Poles.

The Axe tree of the worlde, is named the Diameter of it, aboute whiche it tourneth. and the endes of that Axe tree, are called the Poles of the world. of whiche poles one is named the Northe pole, and the other the South pole. The North pole is alwaies seene of vs where as we dwell, and the Southe pole is neuer seene in this oure contrye, but is euer more vnder our Horizonte, and that as lowe, as the Northe pole is highe aboue our Horizonte.

Schollar. I haue beene taughte to knowe the Northe pole; and I haue marked it oftentimes, wherby I perceaued a great numbred of starres to moue aboute it, and were sometymes higher then it, and sometymes lower then it: nowe on the easte syde of it, and nowe on the west syde: but that pole starre seemed not to sturre oute of his place at anye tyme: whereby I gather, that he is neuer oute of sighte to vs, when the starres appeare, and that is all the nyghte. but what becommeth of him in the daye tyme, I can not tell.

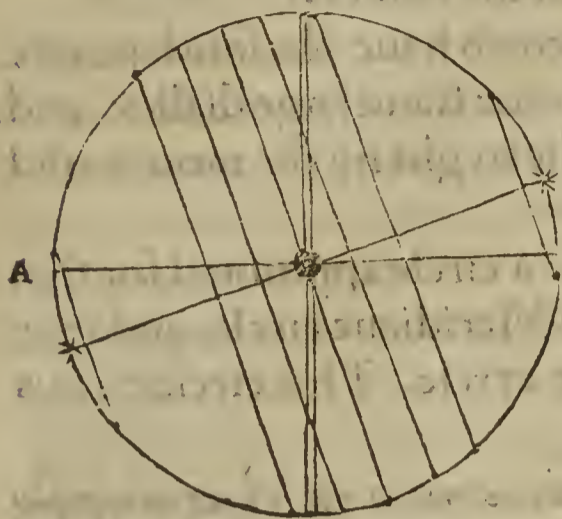
The Hori-  
zonte.

Master. I wyll cleere you of all suche doubttes before I leaue you: but in the meane tyme I meruaile you founde no doubtte at the name of the Horizonte.

Schollar. That name I learned to signifye that cyrcle, whiche goeth along by the edge of the ground, and parteth that parte of the worlde whiche we see, from that part which we se not: & when the Son riseth, then is he in our horizonte, & so is he, when he is goyng downe as lowe as we can see him.

Master. This is not greatlye amisse, the lyke expressyng of it

Here the Horizonte is represented by the lyne A. C.



of it dooth Hyginus vse in his fyrste booke, and in the.iii. also of his astronomye: but Proclus in his Sphere, dooth define it thus.

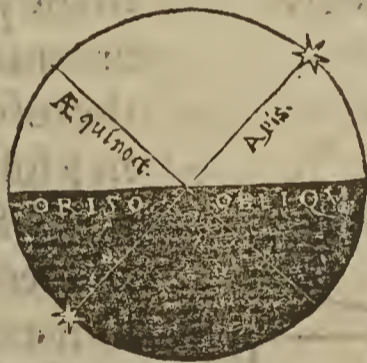
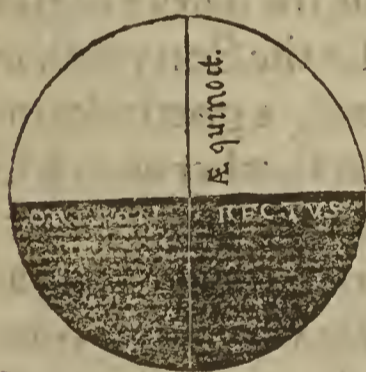
Ὁρίζων δὲ ἐστὶ κῶκλος ὁ διορίζων ἡμῖν τὸ, τὸ φανερόν καὶ τὸ ἀφανές μέρθ· τὸ κόσμος, καὶ διχοτομῶν τὴν ὅλην σφαῖραν τὸν κόσμον, ὥστε ἡμισφαῖριον μὲν ὑπὲρ γῆν ἀκλαμβάνεσθαι, ἡμισφαῖριον δὲ ὑπὸ γῆν.

Horizon vero circulus est, qui conspectam mundi partem ab incon-  
specta dirimit: itaq; in duas partes vniuersam Sphæram secat, vt alterū  
hemisphærium supra terram, alterum sub terra relinquat.

The Horizonte is a cyrcle whiche parteth that parte of the  
worlde that wee see, from that whiche wee see not: and it de-

And here the Horizonte is the edge betwene the  
lyght parte (whiche standeth for that whiche wee  
see) and the darke part whiche dooth signifie that  
whiche wee can not see of the skye.

uideth the whole  
sphere of þ world  
into twoo equall  
partes, in suche  
sorte, that half of  
that sphere is e-  
uer aboue the  
grounde, & halfe  
alwaies vnder the  
earthe. This cyr-  
cle you perceauē  
to be necessary in



the materiall sphere, seynge it hath so greate vse in the hea-  
uenly motions, that by it we iudge the risynge and settings  
of the Sonne and the Moone and all other starres. what say  
you then for the noone steede of the day, from whiche you  
reken all your houres, as it appeareth both by the clockes  
and dyals? for as the clocke striketh one nexte after noone,  
and

The meri-  
dian circle

and so increaseth forward in the numbꝛe of houres, so likewise are your howers marked in the dialles.

Schollar. I thinke it very meete to haue the south point well knowne, as well for this, as for standynge dialles, and for knowledge of the tyme of the nyght by the moone, and by other starres.

The None-  
steed circle

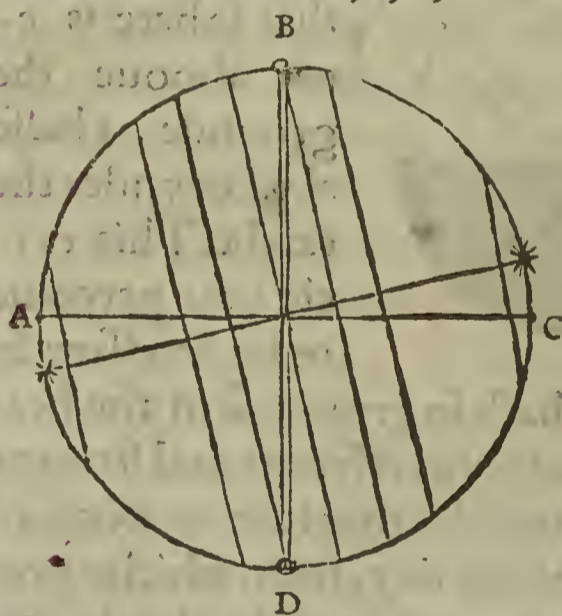
Maister. Then muste there be a circle appointed for that vse, whiche is called therfore the Meridiane circle, and may be named well the Noonesteede circle. This circle is thus defined by Proclus.

μεσημβρινὸς δὲ ὅστις κύκλος, ὁ δὲ τῶν τοῦ κόσμου πόλων καὶ τοῦ κατὰ κεντρὴν σημείου γραφομένου κύκλου. ἐφ' οὗ γηγόμην ὁ ἥλιος τὰ μέσση τῶν ἡμερῶν, καὶ τὰ μέσση τῶν νυκτῶν ποιεῖται.

Meridianus circulus est, qui per mundi polos & punctum, quod nobis supra verticem eminet, ducitur. in quem cum sol incidit, medius dies, mediasq; noctes efficit.

The Meridian is a cyrcle drawē by the poles of the world, & the point right ouer our heads, in which circle whē the Son is, he maketh the myddle of þ day, & the middle of þ nyghte.

Nowe farther to procede to other partes needfull in the sphere. you do se, that twise in the year the daies & nights are equall, & the Son riseth in the iust east, & goeth doune in þ full west, wher as in þ sōmer þ Son riseth northeast, and setteth northwest: & at nonetide is very high ouer our heds: but in þ winter, cōtrary ways þ son riseth south east, & setteth southwest: & at nonetide is very low. thynk you not that these thre boundes of the course of the Son would be well noted, and haue their peculiar circles, for distinction of those tymes?



Schol-

Schollar. I thynke nothinge more needefull then that.

Master. These thre circles (with two other that I will next speake of) are named the five Paralleles: and the middle circle of those, is named the Equinoctiall, bicause that when the Sonne is vnder it, the dayes and nyghtes are equall in all the worlde, except only twoo places. This circle is thus defined by Proclus.

ἰσημερινὸς δὲ κύκλος ἐστὶν ὁ μέγιστος τῶν πέντε παραλλήλων κύκλων, ὁ διχο-  
μέμειος ὑπὸ τοῦ ὀρίζοντος, ὥστε ἡμικύκλιος ὑπὲρ γῆν ἀρραμβάνει, ἡμικύκλι-  
ος δὲ ὑπὸ τοῦ ὀρίζοντος, ἐφ' οὗ γηρόμενος ὁ ἥλιος πᾶσι ἰσημερίαν ποιεῖται: τὴν  
ἑαρινὴν καὶ τὴν φθινοπωρινήν.

The Equino-  
ctial circle

Aequator, circulus is est, qui maximus æquidistantium circulorum sta-  
tuitur, ita nimirum ab Horizonte dissectus, vt alter eius semicirculus  
supra terram, alter sub terra condatur: in hoc sol duplex æquinoctium,  
vernum autumnaleq; facit.

The equinoctiall circle is the greatest of the five Parallele  
circles, and is deuided so equallye into two partes, by the  
Horizonte, that the one halfe of it is aboue grounde, and  
the other is vnder the horizonte: and when the Sonne is in  
this circle, he maketh the daies equall with the nyghtes, ones  
in the Springe tyme, and againe in the Haruest. This equi-  
noctiall circle and the other seuen that folowe, to be decla-  
red, doo moue all as the skye moueth. but the Horizonte  
and the Meridian doo not moue with the heauen, but stand  
stedye, and keepe their places.

Howe to  
knowe the  
place of  
the circle  
equinoctial

Schollar. That seemeth reasonable, els coulde not men  
knowe the risynge, setting, and noonesteed of the Sonne. but  
howe shall I knowe this equinoctiall circle in heauen, seynge  
I can not see any suche circle there?

Master. Marke the course of the Sonne aboute the ele-  
uenth daye of Marche, or els about the fourtenth daye of  
Septembre, and so may you best vnderstande the place of  
this circle, for at those two tymes the Sonne runneth dire-  
ctly vnder the equinoctiall circle, and dothe (as it were) de-  
scribe it by his motion, in four and twenty howers. And if

Howe to  
knowe the  
place of  
the circle  
equinoctial

you

you lyfte to marke the ryfing of the sonne that daye, you maye know the precise pointe of the easte, and at nyghte he setteth in the iuste poynt of the weste.

Schollar. I woulde I knewe as good markes of the other cyrcles.

Master. So wyll I geue you in their conuenient places and times good orders to know them al: and first I must tel you, that these other two cyrcles, which I named before (with the equinoctiall) are called the two Tropike cyrcles after the greeke deriuation, and maye be called in englyshe the Sonne boundes, bycause the Sonne doth neuer passe them, nother towards the northe, nor yet toward the southe: but when he toucheth any one of them, he doth tourn his course toward the other, as for example: All the tyme from the myddle of December vntill the eleuenth daye of Iune, you maye per-

*Examples of those circles and other  
that foloweth.*

A, C. the Horizonte.

\* \* The poles of the worlde.

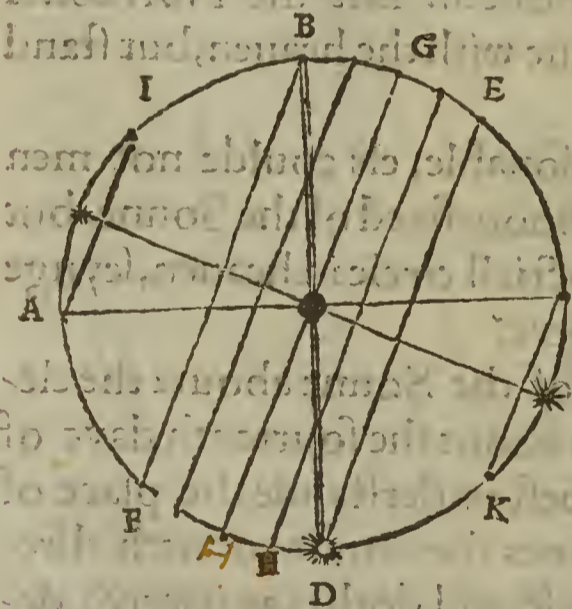
G, H. The Equinoctiall circle.

B, F, one tropike, and

E, D. the other tropike.

A, I, the artike circle,

C, K. the antartike circle.



The know  
ledg of the  
ij. tropikes

The Sommer  
tropike.

The win-  
ter tropike

ceau the Sonne to ryse higher and hygher, and that daye hee is at the hyghest that hee canne go towards our heads, and then dooth hee by his course describe that Sommer tropike, after whiche daye hee draweth agayne lower and lower euerye daye, tyll the twelfte daye of December, for then he is at the lowest, and that daye he doth describe the Winter tropike. Nowe marke howe Proclus defi-

νερνός δὲ τροπικὸς κύκλος ἐστὶν ὁ βορειότατος, πρὸς τὸν ἥλιος γραφομένη κύκλων, ἐφ' οὗ γυμνάζεται ὁ ἥλιος τὴν θερινὴν τροπὴν ποιεῖται, ἐν ᾗ ἡ μέγιστη μὲν πασῶν τῶν ἐν τῷ ἐνι-  
αυτῷ

αὐτῶν ἡμέρα, ἐλαχίστη δὲ ἡ νύξ γίνεται. μετὰ μὲν τοὺς τὰν θερινὴν τροπὴν δὲ ἐπὶ  
πρὸς τὰς ἀρκτους παροδεύων ὁ ἥλιος θεωρεῖται, ἀλλ' ἐπὶ θάτερα μέρη τρέπεται  
τὸ κόσμος, διὸ κέκληται τροπικός.

\*Solstitialis autem circulus is est, qui omnium, qui a sole describuntur, maximè septentrionalis habetur. in quem quum se sol receperit, æstivā reciprocationem peragit, longissimusq; totius anni dies, brevissimaq; nox erit. post hanc autem reciprocationem, nequaquam ultra verus septentriones solem progredi, quin potius ad diversa mundi. regredi cœnas. vnde & Tropico græce nomen.

The Sommer tropike is the moſte northerlye circle of all the that the Sonne describeth; in the which when the Sonne is, he maketh his Sommer turne, at which time is the longest day of al the year, and the shortest night; for after this Sommer turne, you ſe the Sonne go no more toward the north, but turneth to the contrary coaſte of the worldc, and therof is that circle named (in greeke) a Tropike: that is to ſaye, a Returninge circle, or a circle of Returne.

The Sonne after he beginneth to turne, maye be perceaued euery day, or at the least euery weeke, and chiefly at nonetide to waxe lower & lower, vntill he come to the Winter tropike, and there he turneth againe, as by the definition of that tropike you may vnderſtande.

χειμερινὸς δὲ τροπικὸς κύκλος ἐστὶν ὁ νοτιώτατος τῶν ὑπὸ τοῦ ἡλίου γραφομένων κύκλων, κατὰ τὴν ὑπὸ τοῦ κόσμου γινομένην περιστροφὴν. ἐφ' οὗ γενόμενος ὁ ἥλιος τὴν χειμερινὴν τροπὴν ποιεῖται. ἐν ᾗ ἡ μέγιστη μὲν πασῶν τῶν ἐν τῷ ἐνιαυτῷ νύξ ἐπιτελεῖται, ἐλαχίστη δὲ ἡμέρα. μετὰ μὲν τοὺς τὰν χειμερινὴν τροπὴν δὲ ἐπὶ πρὸς μεσημβρίαν παροδεύων ὁ ἥλιος θεωρεῖται, ἀλλ' ἐπὶ θάτερα μέρη τρέπεται τοῦ κόσμου, διὸ κέκληται καὶ οὗτος τροπικός.

Brumalis circulus is est, qui omnium circulorum qui a Sole circumacti mundi describuntur, maximè ad austrum pertinet: in quo sol brumalem reciprocationem facit, maximaq; totius anni nox, minimusq; dies efficitur. post hanc metam nequaquam ultra progreditur \*sol, sed ad alteras mundi partes reuertitur: vnde tropicus hic quoque, quasi ver-  
filis, appellatur.

The winter tropike, sayth Proclus, is the moſte ſoutherlye

C.i.

circle

Linacer  
nimium co-  
actè com-  
mune no-  
mē utriq;  
tropico æ-  
stiuo vni  
tribuit, at  
Plinū im-  
portune  
secutus.

The winter  
tropike

Intellige  
versus au-  
strū quod  
& græcè  
additur.

circle of all them that the Sonne doth describe, by the reuolution of the worlde, in whiche when the Sonne is, hee maketh his Winterly tourne, and then is the longest nyghte in all the year, and the shortest day, for after this Winter turn, the Sonne is not seene to go any farther towards the south, but tournith to the contrarye coastes of the worlde, and thereof is this cyrcle also named a Tropike or cyrcle of Retourne. And thus haue we the three circles that are principallye noted for the course of the Sonne. Nowe are there other twoo whiche be Paralleles with these thre, whereof the one is more southerlye (to vs) then is the Winter tropike, and the other is more northerly, the is the Sommer tropik, whiche whether they be needfull or not, their vse maye declare. I remembre, that you sayd, you had oftentimes beholden the Northe pole, where you myghte see inanye starres about it, that neuer go vnder our Horizont. do you not thinke it good that all those starres were inclosed in a circle to be discerned from al other, which rise somtime about the Horizont, and somtime againe do set vnder the same?

*The southe  
and northe  
circles.*

Schollar. Yes verilye, it were pleasaunt to know.

Mastr. And profitable also, as you shal hereafter perceau.

*The vse of  
the Arctik  
and Antara  
ctik circles*

Now contrary waies, there are other starres, that are neuer seene of vs in this cuntrye, and yet muche mention is made of them in writers, were it not good that their bounde were marked, that all other maye be knownen from them?

Schollar. Els myghte men often looke for suche starres as they reade of, and shulde loose their labour, for they shall not see them.

Master. And yet are there goodlye bryghte and notable starres, whiche are not seene here, but in southe Spaine, in Barbary, in Guinea and Calecut, and many other cuntries, they appeare fayre and pleasaunt to beholde.

Scholar. I pray you, what call you those cyrcles that incloseth those starres?

Master. They are named after the coaste of the worlde where

where they bee. So that the circle whiche incloseth all those starres that be about the Northe pole, is named the Arctike circle or Northe circle; and the contrary circle in the south, is called the Antartike circle by the greeke composition, as you woulde say, Contrary or against the Arctike circle; and it may well be called the South circle. But nowe heare howe Proclus defineth them.

Ἀρκτικός μὲν ἐστὶ κύκλος ὁ μέγιστος τῶν ἀέθρων κύκλων, ὃ ἐφαπτόμενος τῷ ὀρίζοντι καθ' ἓν σημεῖον, καὶ ὅλος ὑπὲρ γῆν ἀρραμβανόμενος. ἐν ᾧ τὰ κείμενα τῶν ἀστρῶν ὅτε δ' ὕσιν, οὐτ' ἀνατολὴν ποιεῖται. ἀλλὰ δι' ὅλην τῆς νυκτὸς περὶ τὸν πόλον σφαιρόμενα θεωρεῖται.

The Arctik circle.

Septentrionalis circulus est is, qui omnium quos perpetuo cernimus, planè maximus est, quicquid Horizontem solo puncto contingit, totus supra terrā interceptus. intra hunc quaecumque clauduntur astra, nec ortū nec occasum norunt, sed circa polum uerti tota nocte cernuntur.

The Arctike circle is the greatest of all those circles whiche do alwaies appear, and toucheth the Horizonte in one only point, and is all together aboue the earthe, and all the starres that bee within this circle nother rise nother sette, but are seene to runne rounde about the Pole all the nyghte.

Thus haue you the fourth parallele, Nowe resteth the fyfte whiche is described thus of Proclus.

Ἀνταρκτικός δὲ ἐστὶ κύκλος ἴσος καὶ παράλληλος τῷ ἀρκτικῷ, καὶ ἐφαπτόμενος τῷ ὀρίζοντι καθ' ἓν σημεῖον, καὶ ὅλος ὑπὸ γῆν ἀρραμβανόμενος. ἐν ᾧ τὰ κείμενα τῶν ἀστρῶν ὅσα πᾶν τὸς ἡμῖν δεινὰ ὁράτα.

The Antarktik circle.

Antarcticus vero circulus æqualis & æquidistans Septentrionali circulo est, & Horizonti vno puncto contingens, totus præterea sub terris immersus, intra quem sita astra semper nobis occulta manent.

The Antartike circle is equall and equidistant to the Arctike circle, and toucheth the Horizonte in one only point, and is all vnder grounde, and all the starres that be in it, are euer more out of our sighte.

These are al the Paralleles which are wont to be set forth in the materiall sphere, and that agreeably of all men, saue that

C.ñ.

rou-

The zodi-  
ake.

touchinge the two laste circles there is a difference, of which I will instruct you at large in the next part of our talke, and omitting it for this time, will go forward to other thre circles whiche yet remaine, and are needfull to oure sphere. By cause oure chieffe consideration consisteth aboute marking of the motions of the Sonne, the Moone and the other planetes, howe they chaunge their places in the skye, and therefore make diuers apparaunces to vs that beholde them, and mark their courses, and yet all they haue (as it were) one common path or waye, from whiche they swarue not, but kepe them selues still within the limites of it: how think you is not that path of theirs well to be marked, and worthy to haue a notable name?

Schollar. Mary that is the principall pointe (as I take it) of all the reste: for without knowledge of that, nothing els can be knowne.

The .xij.  
signes.

Master. That common path of the Planets, wherein all thei haue their course, is called of Astronomers the Zodiake: whiche is, as you maye englishe it, the Circle of the Signes: whiche signes are the greatest and notablest partes of that circle, and were inuented for the more exacte distinction of the motion of the Planetes monethlye. For as there bee but twelue monethes in the yeare, so there are twelue partes of the Zodiake distincte by seuerall names, and correspondent to euery moneth, althoughe they varye something now from their first application, wherof hereafter I will instructe you sufficiently. and now will touch them briefly as this place doth require. Their order in the zodiak and their names ar these that folow, in greek and latin, which maye bee englishe as I haue vnder written, and are often tymes mentioned of our english Poetes.

κρίος.	ταῦρος.	δίδυμοι.	καρκίνος.	λέων.	παρθένος.
Aries.	Taurus.	Gemini.	Cancer.	Leo.	Virgo.
the Ramme.	the Bull.	the Twinnes.	the Crabbe.	the Lyon.	the Virgin.
♈	♉	♊	♋	♌	♍
					χιλαε

χηλαί. σκorpion. ὡξότης. αἰγόκερως. ὑδροχόος. ἰχθύες.  
 Libra. Scorpius. Sagittarius. Capricornus. Aquarius. Pisces.  
 the Balance. the Scorpion. the Archer. the Goate. the Waterman. the Fishes.

♎      ♏      ♐      ♑      ♒      ♓

And bicause that their names alwaies can not bee placed in small instrumentes, there ar certain figures deuised for their names, whiche I haue also sette vnder their names, that you maye the better knowe them. These Signes are all of one lengthe, eche beyng the iuste twelfth parte of the Zodiacke. And for exacter knowledg of the motion of the planettes euerye daye, eche Signe is deuידed into thyrtye equall partes, which are called Degrees, so that in the whole circuite of the zodiacke there must bee 360 degrees, whiche agree almost with the dayes of the yeare.

The degrees of the signes.

Scholar. And therby I gather, that as the Son doth moue throughout all the zodiacke in a yeare, so euerye moneth he moueth, he runneth one signe, & euery daye nere one degree.

Master. You gether well, but this muste you marke also, that by this same nombre of degrees all the cyrcles in the sphere are deuידed, so that of euery circle greate or lesse, a degree is the 360 parte and not anye measure certaine, as a foote, a yarde, a myle, or suche lyke.

what a degree is in measure.

Schollar. I vnderstande you thus: as a quarter is no measure certaine, but sometime is referred to one thinge, and sometime to an other, and yet still it betokeneth the fourth parte of that wherynto it is referred, for when we say: a year and a quarter: an houre and a quarter: a yard and a quarter: a quarter of a foote: in all these sayings, the quarters differ. so when wee saye: a quarter of corne: a quarter of clothe: a quarter of pepper: a quarter of allame: by the accustomed measures all men vnderstande our meanynge, and yet these quarters differ, and be in common meaning, a quarter of a weye, or eight bushels, a quarter of a yarde, a quarter of a pounce, a quarter of a hundreth.

Master. So is a degree the thirtieth parte of a signe, and a  
 C. iij.      signe

signe the twelfth parte of any circle. howe be it, commonlye & chiefly the name of Signes, is attributed to the Zodiak. (whiche many doo call the Thwarte circle) This Zodiake is thus described of Proclus.

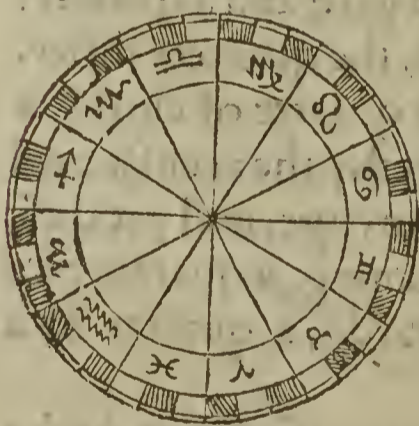
The zodi-  
ake.

λογος δὲ ὅτι κύκλος ὁ τῶν .ιβ. ζωδίων, αὐτὸς δὲ ἐκ τριῶν κύκλων παραλλήλων συνίστηκεν, ὥς οἱ μὲν τὸ πλάτος ἀφορίζειν λέγεται τὸ ζωδιακοῦ κύκλου, ὁ δὲ ὅσῳ μίσην τῶν ζωδίων καλεῖται. οὗτος δὲ ἐφάπτεται δύο κύκλων ἴσων καὶ παραλλήλων, τὸ μὲν θερινοῦ τροπικοῦ κατὰ τὴν τῷ καρκίνου πρώτῃ μοῖραν, τὸ δὲ χειμερινῷ τροπικῷ κατὰ τὴν τῷ αἰγυρίωτος πρώτῃ μοῖραν. τὸ δὲ πλάτος τὸ ζωδιακοῦ κύκλου ὅτι μοῖραι .ιβ. λογὸς δὲ κέκληται ὁ ζωδιακὸς κύκλος, ὅσα τὸ τέμνειν τοὺς παραλλήλους κύκλους.

Obliquus circulus is est, qui duodecim signa continet, ex tribus æquidistantibus circulis constans: quorum duo latitudinem signiferi determinant, vnus per media signa ductus vocatur. hic adeo duos pares & æquidistantes circulos attingit, Solstitialem in prima Cancrī parte, Brumalem in Capricorni principio. Latitudo Signiferi continet partes duodecim. Dicitur est autē hic circulus Obliquus, quod æquidistantes (ad inæquales angulos) interfecet.

The thwarte cyrcle (or zodiake) is the cyrcle of the twelue signes, and is made of thre circles, wherof two are the boundes of his bredthe, and the thyrd is called the Middle signe circle, (bicause it goeth by the middle of the signes in the

This whole circle representeth the zodiake, and the myddle circle signifieth the ecliptike lyne.



zodiake) and it toucheth two equal circles of the parallels: that is to say, the Sommer tropike in the firste point of the Crabbe called Cancer, and also the Wynter tropike in the firste degree of the Goate, called Capricorne. The breadth of the zodiake, containeth twelue degrees. This zodiak is called a Thwart circle, because it crosseth the parallele circles, goynge ouerthwarte them. By these wordes of Proclus you may vnderstande, that the zodiake dooth not

go directly betwene the two poles of the worlde, as all the five paralleles doo, but is drawen crosse the sphere, so that his middle (in breadthe) doth touche the two tropikes, and that middle line is called of latin writers the Ecliptike lyne, bicause there can be no eclipse of Sonne or Moone, onles the Moone be vnder that lyne: as hereafter I wyll declare in place conuenient. But touching this zodiake (of which wee spake laste) I sayde it was diuided into twelue signes, according to the twelue monethes of the year. And bicause euery quarter of the yeare maye bee the more exactlye knowne a sonder, this zodiake is parted into foure partes principall, euery part (as it must needes folow) containing thre signes.

*The Ecliptike line.*

Schollar. This is a very apte agreement of arte vnto nature: for as the whole zodiake agreeth with the whole year, so for the foure quarters of the one, there is foure quarters in the other: and for the twelue monethes of the yeare, twelue signes in the zodiake: and for the thirtie dayes of the moneth, thirtie degrees in euerye signe. But I praye you syr, dooth the beginnige of these signes answere to the beginning of our yeare?

Master. The beginning of the yeare is diuers in dyuers nations, as I will shewe you an other tyme, with the reason why we begin our yeare in Ianuary: but for this tyme it shal be sufficient, to declare the agreement of our yeare with the Astronomers yeare. The Astronomers beginne the twelue signes of the zodiake at Aries, and lykewaise do they begin the yeare that daye and hower, that the Sonne entreth into that signe of Aries, whiche is nowe at the eleuenth daye of Marche: and from thence they reckon the Springe of the yeare thre monethes, whyle the Sonne is in the fyrste three signes. Then at the eleuenth day of Iune, they accompte the ende of the springe, and the beginning of Sommer, bicause then the Sonne entreth into Cancer, whiche is the fourthe signe, and while the Sonne passeth other thre signes, (which maketh the seconde quarter of the zodiake) they accompte

*The yeare when it be ginneth.*

*The spring of the year*

*The Sommer*

C.iiij.

the

Haruest.

winter.

the second quarter of the yeare, which we call Sōmer, & that endureth till the 14 day of September, at which time ꝑ Son entreth into Libra, wher the third quarter of ꝑ zodiak doth begin, & so with it begineth Haruest, which is the third quarter of the year, and cōtinueth till the twelfth day of Decēber, and then doth the Son entre into Capricorn. & Winter beginneth, being the 4 and last quarter, which continueth tyll the eleuenth daye of Marche, where the olde yeare endeth, and a newe yeare beginneth.

Scho. These 4. signes, Aries, Cancer, Libra & Capricorn, seeme to haue a certain prerogatiue, ꝑ they begin ꝑ 4. quarters of ꝑ year, therefore thei wold be well noted in ꝑ zodiake.

The Colures.

Tropike Colure.

\*λ. significat. 30. que semis est circuli maximi diuisi in 60. partes, quod Procl<sup>9</sup> facit. ut perperā quidā λ. hic p λ. substituerint.

Master. You say well, and yet thei haue other notable qualities, for in the beginning of Aries and Libra, ꝑ son maketh the daies equall with the nights. & these 2. points ar named ꝑ equinoctial points. In the first part of Cancer, the day is at ꝑ longest, and beginneth to shorten by the descending of the son frō our heds, & when the son doth enter into Capricorn, the day is at the shortest, & then the son beginneth to returne to vs again, & the day doth thē begin to increase. and these 2. points ar called the η. Tropike points: Wherefore as these 4. points are notable, so are then η. circles appointed for their lymites, the one going by the beginning of Aries & Libra, and the other by the beginning of Cancer and Capricorn. these η. circles ar called Colures, wherof the one only which passeth by Cancer and Capricorn, is described of ꝑ grekes. the reason thereof I will shewe you in the fourthe treatise. But this fyrste colure, whiche is called the Tropike colure, is thus described by Proclus.

ὁ δὲ τῶν πόλων δὲ εἰσι κύκλοι ὑπὸ πινυρ κόλτροι προσεγορευόμενοι, οἷς συμβέβηκεν ὑπὸ τῶν ἰδίων περιφερειῶν ἔνθ' ἔχουσιν ἑκάστην κόλτρον δὲ κέκληνται, ὁ δὲ τὸ μὲν τινὰ ἀθεώρητα αὐτῶν γίνεσθαι. οἱ μὲν γὰρ λοιποὶ κύκλοι καὶ τὰ τῶν περιτροφῶν τῶν κόσμων ὅλοι θεωροῦνται, τῶν δὲ κόλτρων κύκλων μὲν τινὰ ὅτι ἀθεώρητα, τὰ δὲ τῶν ἀνταρκτικῶν ὑπὸ τῶν ὀρίζοντα ἀρραμβανόμενα. γράφονται δὲ οἱ κύκλοι ὁ δὲ τῶν τροπικῶν σημείων, καὶ εἰς μέρη \*λ. ἵσα διαιρῶσι τὸν δὲ μέσων τῶν ζωδίων κύκλον.

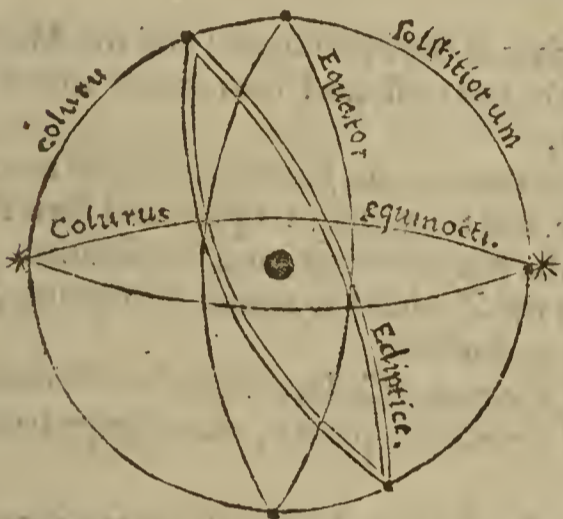
Sunt

THE CASTLE OF KNOWLEDGE.

Sunt & per polos ducti circuli quos nonnulli Coluros vocant: ijs acci-  
dit, vt in ambitus suos mundi polos recipiant. Coluri autem dicti sunt,  
quod partes aliquas in se minime conspectas habent. reliqui enim cir-  
culi in mundi circumactu integri cernuntur, sed colutorū partes quæ-  
piā quæ videlicet ab a Arctico sub Horizonte latent, cerni nō possunt.  
Signantur autem hi circuli per tropica puncta, diuiduntq; per \* duas  
æquas partes circulum qui per media signiferi ducitur.

33 a Antar-  
ctico legē  
dū, cōtra  
exempla-  
rium om-  
nium con-  
sensum.

\*duas ad  
modū ap-  
tē Lina-  
cer trāstu-  
lit loco a-  
literæ, q̄  
semissim  
hic signi-  
ficare, su-  
p̄ra admo-  
nui.



The circles that go by the  
poles are those, whiche some  
men call Colures: thei haue  
the poles of the worlde in  
their circumference. And  
are named Colures in greek,  
that is trunked circles, by-  
cause some partes of them  
come not into oure sighte:  
for the other circles by the  
turning of the world are all  
seene, but some partes of the

Colures are not seene, that is, those partes whiche are in the  
Antartike circle, and remaine vnder our Horizonte. These  
cyrles are drawen by the two tropike pointes of the eclipte  
circle, and so deuide it into two equall partes. The Equino-  
ctiall colure goeth by the poles of the sphere, and by the .ij.  
equinoctiall pointes of the Zodiacke, in Aries and Libra.  
Thus haue you nowe all the cyrcles needfull for a materiall  
sphere. let me heare howe you doo remembre their names.

The Equi-  
noctiall co-  
lure.

Schollar. If I shoulde not remembre theim, I dydde but  
leese my laboure, and occasion you to spend your tyme in  
vaine: for I know that in this science and in all other, he that  
coueteth to runne styll forward, and remembreth not that,  
that is gone before, shall neuer attaine that whiche remai-  
neth behynde, but while he deliteth to muche to see the end,  
he deceaueth him selfe of the frutefull ende of knowledge.  
muchelyke a man that is delited in hearing a cunning song  
of

A good  
lesson.

of musyke, but when it is done, doth remembre nothing of it, so is his profite and pleasure bothe ended, when the song is ended. Therefore (if it please you) I will repeate the chieffe pointes that I haue learned sythe my former repetition.

Maister. Doo so then.

Schollar. This it is as I remembre,

*The second  
repetition.*

1 Fyrst you taught me what a sphere is, and howe it is made, also what is his Centre, his Axetree, his Diameter, and his Poles, and what the Poles are named.

2 Nexte you declared two circles, that is the Horizonte, and the Meridiane circle, whiche (I perceau) stand styll, and tourne not with the worlde, but keepe their places.

3 Then did you describe fve parallele circles, the Equinoctiall, the twoo Tropikes: the Sommer tropike, and the winter tropike, and then the other two Paralleles, that is, the Northe circle, and the Southe.

4 After that, you shewed me what the Zodiake was, and the twelue Signes that be in him, and of their diuision.

5 And laste of all, you described the twoo Colures, whiche diuide the Zodiake into foure equall and principall partes, accordynge to the four tymes of the yeare.

Maister. This good remembraunce declared your good will to knowledge, whiche I shall with as good a will healpe to further. Now you looke (I think) to be instructed in the vse of all these thinges, and to vnderstand therby the celestiall motions, and the diuers appearances that therby doo ensue: how be it, by cause that a materiall instrumēt is a great helpe for them that begin to trauaile in this arte, and dothe as an image represent to the eies those thinges, which by on ly hearing, were very hard to conceaue, besides many other commodities, whiche shall be vttered in their place, I think it moſte conuenient order, fyrst to teache you the manner howe to make suche a materiall sphere, as may serue both to learne by, and also to worke by, in practising the obseruations needefull to this arte.

## OF THE CASTLE OF KNOWLEDGE

wherein is taughte the makinge of the materiall sphere,  
as well in sounde or massy forme, as also in  
rynge forme with hoope s.

M. A. S. T. E. R.



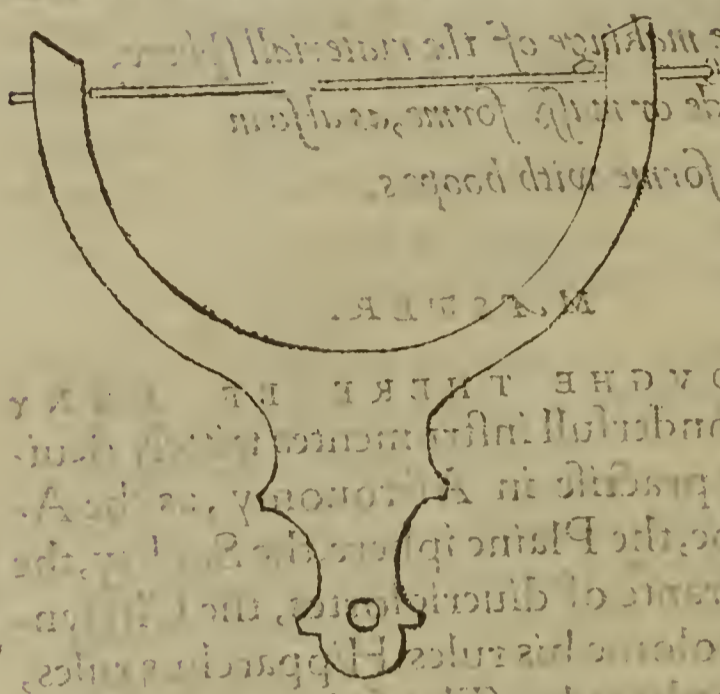
ALTHOUGH THERE BE MANY  
and wonderfull instrumentes wittely deu-  
ised for practise in Astronomy, as the A-  
strolabe, the Plaine Spherc, the Saphcy, the  
Quadrante of diuerse sortes, the Chylyn-  
der, Ptolome his rules, Hipparchus rules,

Instrumēts  
of Astro-  
nomye.

Tunsteedes rules, The Albion, the Tor-  
quete, the Astronomers staffe, the Astronomers ringe, the  
Astronomers shippe, and a greate numbere more, whiche  
hereafter in tyme you may knowe, yet all these are but parts,  
or (at the most) diuers representations of the Sphere. wher-  
fore as the Sphere is the grounde and beginner of all other  
instruments, so is it moſte meete that we begin with it, and  
the rather bycause it dothe more aptlye represent the forme  
of heauen, then anye other instrument canne doo. What a  
Sphere is, you haue learned before: and howe a materiall  
Sphere or Globe maye bee made rounde, you maye conie-  
cture by the same description of Euclide. Therefore muste  
you haue an instrumente of steele made lyke a Semicircle,  
whiche in the inner circumference muste haue a sharpe edge  
apte to cutte and pare smothe, and (as I maye saye) by true  
woorkinge to iustifie your Globe, whiche fyrste maye bee  
made as rounde, as any Turner can doo it. and then shall  
your instrument not only duly examen the Turners work,  
but correct it exactlye if it be anyſſe.

The toura-  
ning of a  
Globe.

This is the forme of that instrumente, and it is thus made  
iustlye. Firſte drawe a righte lyne as longe as you wyll haue  
the



the diameter of your sphere, and any che longer, or more. Then open your compass accordyng to the halfe diameter of the sphere that you would make, and draw halfe a circle, so that the fixed foote of your compass be set in the myddle (as you may nearlye gesse) of the sayd line, and wyth the other moueable

foote make the semicircle, but not fullye complete to the diameter, for there muste bee twoo holes made as bigge as a wheate strawe or bygger, accordyng to the bygnes of the Globe, for thorough these holes muste the Turners spyn- dles pearse, that muste beare the Globe whyle it is in tournynge: but you muste take good heede, that those holes bee so made, that the foresayde lyne doo passe exactlye thorough the verye myddle of them, for so muche as you misse in makynge those holes, so muche will your sphere bee false in euerye quarter. Againe you muste take heede that your instrumente doo not bowe inwarde withoute those holes towarde bothe the poyntes, excepte it bee in true compasse, but better it is to fyle it somewhat a slope outwardelye. What more is to be doone, I leaue it to the studiouse deuylse of your owne practyse. for suche thynges are better taught by hande, then by mouthe.

An other forme of the same woorke.



Schol-

Schollar. I wolde I coulde as well vse it, as I could diuise to make it iuste rounde.

Master. When you haue your globe so iustified in roundnes, marke well the twoo Poles of it, which you may easily do by the same instrument, whereby you did iustifye it, for the spindles that passed through the twoo holes of your instrument, doo touche the twoo poles exactly.

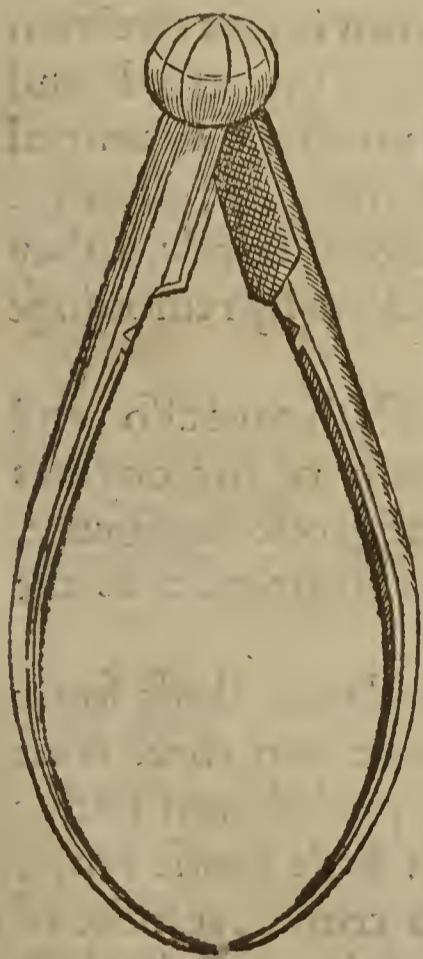
*To find the Poles in a Globe.*

Schollar. That can I easilye doo.

Master. Then muste you haue a payre of compasse aptelye made for to drawe the circles in youre Globe, and the poinctes of the shankes in that Compasse muste bowe somewhat inwarde (as here you see an example) and the poynctes of it muste bee verye fine and harde, that they maye graue deeply, and yet make a fine and small circle. for the fyner that your circles be, the exactlier will the diuisions be made, and the lesse erreure wyll bee in the ma-

kyng and vsyng of the same Globe.

*A compas for a Globe*



Then sette one foote of the compasse in one of the Poles of the Globe, and open the other so wyde, as you thynke will suffice to reache to the myddle of the Globe, towarde the other Pole, and with that foote make a lyghte marke in the Globe: and keepyng youre compasse vnchaunged, putte one foote of it in the contrarye Pole, and tourne the other foote towarde the foresayde marke, in the myddle of the Globe, and if the foote touche it exactlye, then is that myddle duelye founde: but if the compasse reache to farre, or to shorte, make wyth yt an other lyghte marke, and the true myddle betweene

*To make equinoctial circle.*

D.i.

those

those two marks is the iust middle of the Globe or Sphere, as by your compasse a little opened more or closid (as you see cause) you maye prooue.

Schollar. That can I do well ynough, by experience learned in often practisyng the conclusions of youre Pathwaye.

*The Path-  
Waye.*

Master. That Pathwaye wyll leade you rightlye to this woorke, if it bee well trauayled as it oughte to bee before you come to this woorke. But to procede with our Sphere: When you haue founde the iuste myddle of the Globe betwene bothe the Poles, then open youre compasse accor dyng to the distance of that middle marke, and one of the Poles, and set one foote of the compasse in the Pole (whiche you lyst) and with the other drawe a cyrcle rounde about the Globe. whiche whether it bee truelye doone or not, thus

*Proof.*

maye you prooue: Remoue the foote of your compas into the other Pole, and with the mouable foote trye the former circle, & if the compasse run iustly in it, then is that circle truly drawn betwene both the Poles, else haue you erred: and therfore graue not þe circle to deepe, till you haue examined it. And when you haue found it true, then without alteringe of the compas, set bothe feete of it in the sayd circle, & they will take the fourth part of the same circle, as by remouinge it four tymes, you maye knowe.

*The diui-  
ding of the  
equinoctial*

*Proof.*

Schollar. That haue I learned in the Pathwaye also, and if I haue myssed, it is by the grossenesse of the poyntes of my compasse, or else by myne owne grosse negligence, whyche bothe I canne quickly examine and amende, as the case requireth.

Master. After that you haue marked oute those foure partes of that circle, dyuide eche of them into three euen partes, and so haue you that cyrcle dyuided into twelue equall partes: marke those partes with little crosse lynes, or else drawe an other circle wythin a corne breadthe of that other, on which side you list, but let it be somewhat lesse graued

grauid then the fyrste, that the fyrste may bee knowne for the true circle, and this seconde cyrcle to serue but onlye for the markes of diuision in that other: and so drawe a lyne at euerye twelfte parte, from the one cyrcle to the other. Then dyuyde euerye one of those partes into three lesser partes, and eche of theym agayne into euen halues, and so haue you in all, 72. partes made of that cyrcle. After this, diuide one of those partes into fve lesser portions, equallye, and by the same example diuyde all the other 71. partes, and so haue you in the whole circle, 360. partes, whiche you shall marke with nombres of figures, from 10. to 10. beginninge where you lyste.

Schollar. Those I maye call degrees, as I remembre by youre former lessons. and I muste marke them thus. 10. 20. 30. 40. and so vnto 360.

Mast. So it is: And thys circle thus drawen in the middle betwene bothe the Poles, is the Equinoctiall cyrcle in that sphere. Now to make the two Tropiks, open your compas so, that they maye extend to 66. degrees and an halfe of the said Equinoctiall cyrcle. and then set one foot of the compasse in which Pole you will, and with the other foot draw a circle on the Globe, which shal stand for one of the tropiks, and setting the foote of the same compasse vnaltered, in the other Pole, draw about it an other circle, for the other tropyke. Now appointe names for the Poles, callynge one the South pole or Antartike pole, and the other the North pole or Arctik pole: and then the tropikes of necessity will take their names: for that Tropike which is next the North Pole, must be the tropike of Cancer, that is, the Sömer tropike, and the other that is nexte to the Southe Pole, must needes bee the Tropyke of Capricorne, or the Wynter Tropyke. Then marke where you beganne the numbrynge of the degrees in the Equinoctiall (whiche maye well be called the begynninge of the Equinoctiall) and set one foot of your compas in that beginning, openyng the

To drawe  
the twoo  
Tropikes.

The Poles.

The Tro-  
pikes.

The tropik  
Colures.

D.ij.

other

Proof.

A generall  
rule.

The Equi-  
noctial Co-  
lure.

Proof.

The diuisi-  
on of the  
Colures.

other foote tyll it will reache vnto 90. degrees iustlye, and fyrste holde the one foote steddye in the begynninge of the Equinoctiall; and drawe a circle with the other foote, and if that circle touche bothe the Poles of the Globe, then is it trulye drawn. but it should go also by the ende of the 270 degree of the Equinoctiall, and if it misse anye whitte, examine it well, and amende the faulte, before you woorke anye farther. whiche rule you shall obserue styll, for els of one faulte neglected, many other may ensue.

This doone keepe youre compasse at the same wydenesse, and sette one foote in the Equinoctiall circle, at the ende of 90 degrees, and holdynge it steddye, with the other foote describe a circle, whiche shall passe by bothe the Poles of the Globe, and by twoo pointes of the Equinoctiall, that is the beginnunge of it, and the ende of 180 degrees. and if you haue missed, amende it by and by. This laste circle is the Colure Equinoctiall, and the other last before drawn is the Colure Tropikall, or Solstitiall, or the Tropike Colure. These twoo circles shall you diuide into 360 parts eche of them, beginnunge your numbrynge at the Equinoctiall, and rekeninge towarde the Pole, in euery quarter of them seuerallye, so shall you neuer reckon aboue 90. But it is easilye knowen, that foure tymes nynetye doothe make 360.

Scho. But in this ordre of numbrynge, the cōmon forme of accompte is not kepte, as it was in the Equinoctiall: for when I haue reckened in one quarter 90. degrees from the Equinoctiall to the Pole, then if I go forwarde in the same circle, the nexte numbre beyonde the Pole is nynetye againe, and so that seconde quarter decreaseth from 90 to 10, goynge backwarde, and then the thyrde quarter increaseth from 10 to 90, and the fourth quarter decreaseth againe from 90 to 10.

Proof.

Master. So must it be in these circles for moste aptenesse in accompte, as you shall perceau hereafter. Nowe shall  
it

it be conuenient to mark in what degrees the two Tropikes do cut those Colures, for if you haue not erred, they touch the myddle of the four and twentieth degree in euery quarter of the Colures. And if you haue doone well, then procede to the making of the Zodiake, whiche you shall draw thus. Open your compasse to the same wydenesse that you dydde for making the Colures, or the equinoctiall, & then reckon from one of the poles (whiche you will) 23 degrees and an halfe, in any one of the Colures, and it will lighte in 66 degrees and an halfe, bycause the numbres from the poleward go backward. (as you confessed before) then with a lesser compasse (for it shall bee meete that you haue diuers sorts) draw a circle of that circuit about eche Pole, setting the fixed foot of the compas in the Pole, and stretching the other foot vnto 66 degrees & a half. After this looke whether these circles do cut lyke degrees in euery quarter of the Colures: and if it do, your woorke is righte, els it must be redressed. These circles maye well bee called Pole circles, or Polar cyrcles. Then take your greater compasse opened (as is before declared) to the wydenesse of a quarter of the Equinoctiall, and sette one foote of them in that poyncte where the Polare circle that is aboute the Northe pole, dooth crosse the tropyke Colure in that quarter, whiche goeth from that same Pole, to the 270. degree of the Equinoctiall, and holdynge that foote steddye, with the other drawe a circle aboute the Globe. This circle will touche the two Tropikes in twoo of those places, where they crosse the Tropike Colures: and also it wyll crosse the Equinoctiall in twoo pointes, that is, in hys very begynnynge, and in the ende of the 180. degree. Nowe to proue whether it be truely drawen or not, by an other meanes, set one foote of that compasse (with whiche yow drew the Zodiake) in that pointe whiche is directly contrarye to the firste place, where you stayed hit: that is to saye, in the crosseynge of the southe Polare circle, and that quarter of the tropyke Colure, whiche goeth from the South pole to the 90. degree of

Pole Cir.  
cles. 2.

The dra-  
wing of  
the zodiak.

Proof.

An other  
proof.

D. iij.

the

*The Poles  
of the Zodi-  
ake.*

the equinoctiall, and on that point proue whether the mouable foot of the compasse will exactly agree with the foresayd circle, whiche yf he doo, it is well drawen, els is there some erreure, which muste bee amended. This circle thus drawen, is the Ecliptike circle, whiche goeth by the myddle of the Sygnes and of the Zodiake. and these two poyntes wherein the fyxed foote of the compasse was stayed, are the Poles of the Zodiake. But considering that the Zodiake (as you hearde before) hath in it twelue degrees of bredthe, that is, on eche syde of the Ecliptike lyne fixe, therefore open your compasse to 84. degrees only, that is fixe degrees lesse then a quarter of the Equinoctiall, and set one foote of it fixedly in the one Pole of the Zodiake, and with the other moueable foote drawe a circle, whiche wyll be a Parallele to the Ecliptike circle, distaunte from it in all partes by 6 degrees, and with the same compasse vnaltered, draw a lyke circle on the other Pole of the Zodiake, whiche shall bee a Parallele to the other twoo, and they three do make the full Zodiake in length and breadth.

*The Polare  
circles and  
their vse.*

Schollar. I vnderstande all this verye well, but I muse what those Polare circles meane, of whiche I hearde no woord before in the firste treatise.

Master. I dyd of purpose omitte them before, bicause they are named of diuers men, as of Ioannes de Sacro Bosco and other later writers, for the circles Arctike and Antarktike, contrarye to Proclus, and all the greeke writers, and I purposed (and so doo I still) to reserue the discussing of that repugnance, to the fourthe treatise, yet here was suche iuste occasion ministred to vse their helpe in fyndynge the poles of the Zodiake, by whiche poles they are described every day, by the reuolution of the heauens, that I coulde not willyngly neglecte them: for although I myghte fynde the poles of the Zodiake without them, yet they bringe a proof of the woorke with them, as before I haue shewed, and also they enclose all suche starres as are within 23. degrees

grees and a halfe of the Pole, and are the lymites of the motion that the Poles of the Zodiake doo make about the poles of the worlde, as you shall better perceave hereafter. And bycause their names shoulde not bee confounded with the circles, Arctike and Antarctike, I thinke it moste meete to cal them only Polare circles, or Pole circles, which name the other circles may not iustly challenge, especially bycause they are not fixed (as the Pole circles are) but be chaungeable as the regions chaunge. which thing I will declare more largely hereafter, but nowe for the drawinge of the circles Arctike & Antarctike, that is (as I named them) the Northe circle, and the Southe circle, you muste learne the eleuation of the region for whiche the Globe is made, and according to it must you draw those circles, whiche thinge bicause as yet it is not easye for you to doo, I will in example of oure owne cuntrye shew their description, namely for the vniuersitye of Cambridge, whiche standeth in euen degrees of 52. Therefore reckon from one of the Poles 52. degrees in anye Colure, and it will lyghte on 38. degrees (bicause the numbers go backward) and there set one foote of your compas, extending the other foote to the next Pole, where you shall staye it, and with the other foote describe a circle fyrst about the one Pole, and then about the other: and those two circles shall stand for our circles Arctike & Antarctike. And thus hath the Globe all those circles whiche were accompted needfull vnto it, excepte the Horizonte and the Meridiane circle, whiche are not so well placed in the Globe as without it, bicause they ought not to moue with the Globe.

*Circles ar-  
ctike and  
Antarctik.*

Schollar. Where shall they be made then?

Master. That will I shewe you, as soone as I haue ended the Globe, whiche yet is not doone, for the Signes in the Zodiake are yet vndrawn. First therefore ye shall drawe by the Ecliptike line within a corne bredth of it, an other circle as you did by the Equinoctiall, it forceth not on whyche side, but let the Ecliptike line be more notable then it. Then

*The diuisi-  
on of the  
zodiake.*

D.iiij.

consider

consider that the Zodiacke is all ready diuided into foure equall quarters by the two Colures, now it is meet to diuide euerye quarter into three equall partes, and so haue you twelue partes in the whole Zodiacke, which stande for the twelue Signes, which shall be distinct by lynes drawn ouer thwarte all the breadth of the Zodiacke.

Schollar. Those are not easie to drawe, but errorr may quickly be committed, in making them wyder in one place then in an other.

*Proof.*

Master. Therfore to auoyde that errorr, thus shall you do. Open your compas equally with a quarter of the Zodiacke. then keepe one foote of it steddy in eche diuision, one after an other, and with the other drawe a portion of a circle crosse ouerthwart all the breadth of the Zodiacke, & thus shall you do it exactly, and in so doing, your compasse doth trye and examine the former diuision: for if at anye setting of your compasse it reache to shorte, or to far, and not iustly on the thyrde signe, then must you correct your fyrst diuisiō. When you haue drawn these twelue signes, the must you diuide euery one of them fyrste into two partes equally, and eche of them againe into three euen partes, and lastlye, euery one of them into fiue iuste portions, and so haue you in euery Signe, thirtye partes or degrees.

Schollar. This diuision is like the diuiding of the Equinoctiall and the Colures, so that I maye conceaue the one by the other.

Mastr. In deed they ar all thre lyke in their general diuisiō, but yet in placinge of their numbres, they differ eche from other, for the Equinoctiall had his numbres continuallye proceeding from 1. to 360. The Colures, stay their numbres at euery quarter, neuer proceedinge aboue 90. but the Zodiacke stayeth in a lesser nombre, for at euery signe, his numbres chaunge: so that from the beginning of eche Signe to the ende of the same, you shall marke them from 10. to 10. thus: 10. 20. 30. and so lyke in all the Zodiacke no nombre is greater

greater then 30.

Schollar. I perceauē that, sith you tolde me before, that euery Signe feuerally hath 30 degrees.

Master. Those diuisions shall you marke with a little line drawn from the Ecliptike circle to that other which is drawn within a corne bredth of it: yet at euery tenne degrees it will do well to draw the line somewhat longer from the Ecliptike, that those degrees maye be the easier to see and to reken, and so maye you doo at euery five degrees, but somewhat shorter then that other, and so shall you haue the degrees more notablie distincte in sonder. Nowe resteth no more but to geue euery Signe his name, which you may do other by writinge it at lengthe, or els by settinge their Characters and figures for their names, which I before haue set forthe vnto you in bothe formes.

Schollar. That is easye inough to vnderstande, but how shall I knowe their places?

Master. That is as easye also, if you marke the ordre of the circles. but for a full plainesse you maye beginne at the Tropike of Cancer, where the signe of Cancer doth begin, and in that quarter of the Zodiake, which is on your right hande, and descendeth toward the Equinoctiall, sette these three signes, Cancer, Leo, Virgo, and so procede forward as the signes succede in ordre: then will the seconde quarter haue Libra, Scorpius, and Sagittarius; and the third quarter, Capricornus, Aquarius and Pisces: and to make vp the fourth quarter, ther resteth Aries, Taurus and Gemini.

Schollar. You name the seconde quarter of the Zodiake to be the fyrste, and so commeth it to passe, that you call the fyrste quarter the fourthe, as I remembre youre former doctrine.

Master. You maye perceauē, that I named them nowe not in their custumable ordre of quarters, but accordynge to the ordre of this woorke, els if you can discerne the place of Aries from the place of Libra, you may best begin with

Aries

quarters of the zodiacke	The quarters of the yeare.	The Signes in euerye quarter of the zodiacke, aunsweryng to eche quarter of the yeare.		
1.	Springe.	Aries,	Taurus,	Gemini.
2.	Sommmer.	Cancer,	Leo,	Virgo.
3.	Haruest	Libra,	Scorpius,	Sagittarius.
4.	Winter.	Capricornus,	Aquarius,	Pisces.

Aries, & the not only the signes, but þe quarters wil keep their accustomed ordre, as here in a table it doth apear: wher I haue also annexed the quarters of the year for readines of remembrance, & for the better occasion to marke the motion of the son in eche of those quarters. And thus haue we ended the globe or sphere, with al þe circles in it customably vsed, whose picture here you may se, as it will be drawn in flatte forme.

A, C. is the Equinoctial circle.

E, K. the tropik of Cancer.

Q, L. the tropik of Capricorn

Q, K. The Zodiacke.

B, and D, The ij. Poles of the worlde.

F, I. The Arctike circle.

P, M. The Antarctike circle.

G, H, and O, N. The two Polare circles.

G, and N, The ij. Poles of the Zodiacke.



The making  
of the Ho-  
rizonte.

Now for the Horizōt  
& the Meridiā thus shal  
you do. Take 2. square

bords of a quarter of an inch thick, & let þe one be in bredth 3. inches, & the other one inch & a half more then þe diameter of your globe, in þe middle of the broder borde take a centre, & on þe cētre make a circle, scarcely a corn bredth wider the your globe is, which you shal thus find out. Open your cōpas as wide as ij. signes in þe Zodiak, or 60. degrees in þe Equinoctial, or any

any other of his gréate circles, and that compasse wyll make a circle iust in bignesse with any great circle of your Globe, therfore make you the circle in the square borde, almoste a corne bredthe wyder then that circle of youre Globe. And without alterynge of the compasse, make the lyke circle on the myddle pointe of the narrower borde. Then haue you taken the iust measure for the inner part of your Horizont, and also of your Meridian.

Schollar. I doubt not but I canne doo that with a lyttle labour by often triall where the myddle of the bord is. but is there no waye to fynde the place of the centre quickly?

Master. Yes truly, and that maye you doo diuersly, but one redye way is this.

Drawe with your ruler a right line from corner to corner, or if you lyst, make it onely about the myddle of the bord, as you can ayme with your eye, but be sure that you drawe it longe ynough, then turne your ruler to the other two corners, and make a lyne crosse that other, and where they doo crosse, there is the myddle of the borde, on whiche, as on a



cetre you may make your circles. This work might you easlye gather out of the 35 conclusion of the Pathway.

*The Pathway of Geometry.*

Schollar. I see now continually more and more, that the Pathway serueth to other vses, then I toke it.

Master. It is a common instrument to many arts, and infinite conclusions:

and if you procede to farther knowledge of higher artes, without good exercise in it before, you do as a carpēter that goeth to woorke without his tooles. But nowe to proceede,

when



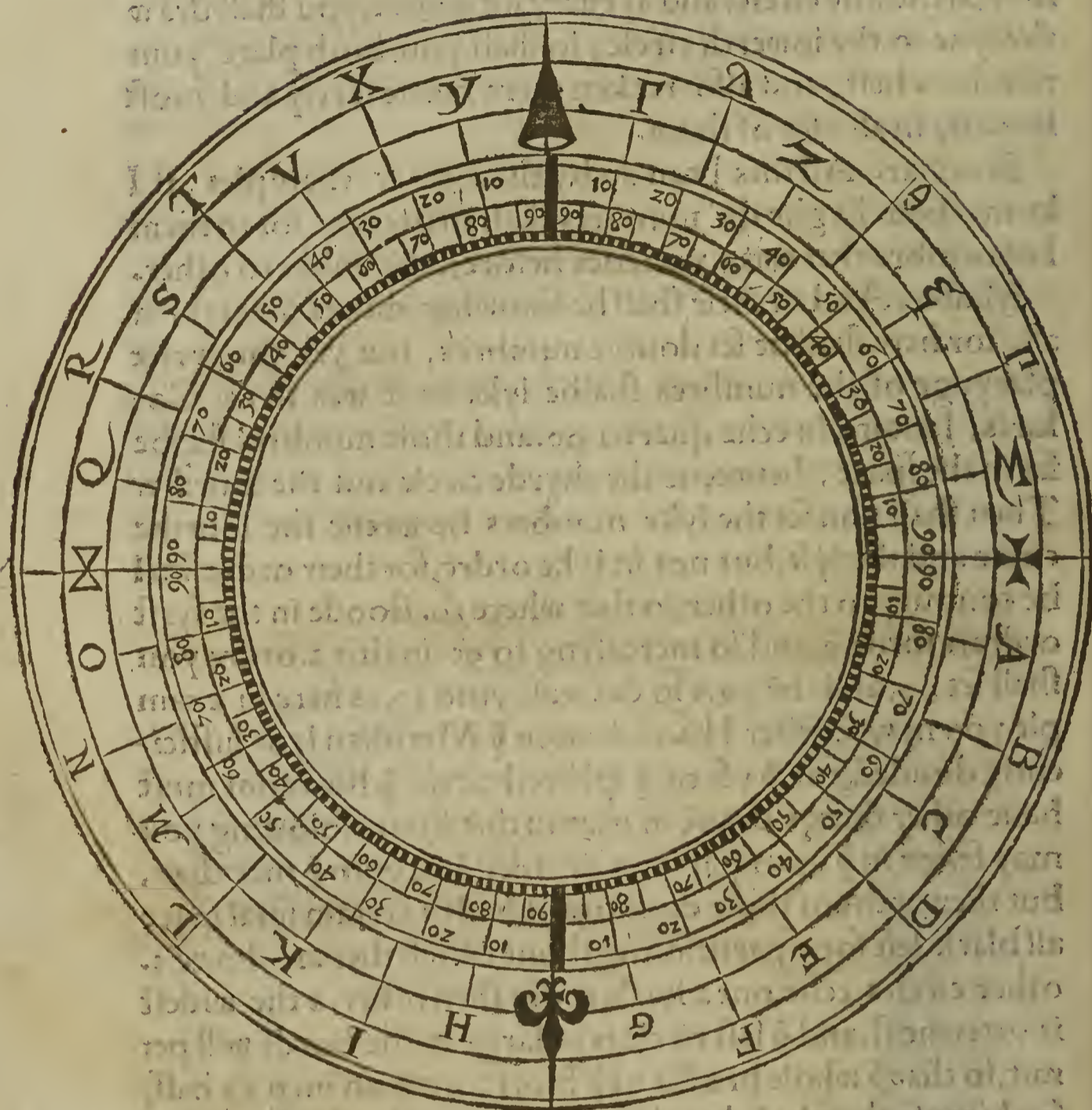
is vnto the fift circle, and at euery fift degree, you shall draw the lyne to the fowerth circle, so shall you both place your numbres best, and also reckon them moſte ſurely and moſt ſpeddily in all vſes of them.

Schollar. All this I can do by the former examples, if I knewe how hygh the numbres ſhall proceede. for in them I remembre ther was 3. varieties before, eche vnlike to other.

Maſter. And in theſe ſhall be ſomewhat diuers from them all. for here ſhall be ſet double numbres, but yet the fyrſte placynge of the numbres ſhalbe lyke as it was in the Colures, I meane in eche quarter 90. and thoſe numbres ſhalbe ſet in the ſpace, betweene the thyrde circle and the fourthe. Then ſhall you ſet the lyke numbres betweene the fourthe circle and the fyrſt, but not in lyke ordre, for their ordre ſhall be contrary to the other, ſo that where 10. ſtoode in the fyrſt ordre, & then 20, and ſo increaſyng to 90. in this 2. ordre you ſhall ſet 90, and thē 80, & ſo decreaſe vnto 10. as here in example you may ſe, wher I haue drawen þ Meridian lyne ſufficiently diuided, for þ vſe of þ ſphere: but thē þ horizont muſt haue other things drawē in it, as in this figure folowing you may ſe. for in þ inner part it is deuided like vnto þ meridian, but then without thoſe diuiſions it hath a certain ſmal ſpace all black, left for a partition, without which ther are drawē 3. other circles, eche one a lyttle wider then other, & the wideſt is vttermoſt, and þ laſt circle is as large as the borde will permit, ſo that þ whole bredth of þ Horizont is an inch & a half, for bicauſe the whole bord was 3. inches wider thē the globe. And þ Meridian ſhalbe but 3. quarters of an inche brode, ſeing his bord was but 1. inch & an half wider thē þ globe. Now for the diuiſion of the vtter part of the Horizont, you ſhall dyuide the vttermoſte of the three circles into eyghte partes only: The ſeconde circle ſhalbe diuided into 16. partes And the third or innermoſt of thoſe 3. ſhall be parted into 32. partes, whiche do betoken the points of the Shypmans compas, or the 32. winds notable in ſailying, as ſome mē lyſt

E.i.

to



to call them. If your Horizonte bee large inoughe, to receaue their names, you shall write them at lengthe, els maye you write letters for theym, as youre owne phantasie lyketh.

Their names are these folowinge, agreable to those places and letters, whiche I haue drawen in the Horizont.

The

## THE NAMES OF THE

THIRTYE AND TWO POINTES IN THE SHIPPE

compasse, whiche bee the Windes names that Mariners  
sayle by.

♠ North.	N. Easte northeaste.
♠ Southe.	O. Easte and by northe.
X Easte.	Q. Easte and by southe.
✝ weste.	R. Easte southeaste.
A. weste and by northe.	S. Southeaste and by easte.
B. west northweste.	T. Southeaste.
C. Northweste and by weste.	V. Southeaste and by southe.
D. Northweste.	X. Southe southeaste.
E. Northweste and by Northe.	Y. Southe and by easte.
F. Northe northweste.	r. Southe and by weste.
G. Northe and by weste.	Δ Southe Southweste.
H. Northe and by easte.	Z. Southweste and by Southe.
I. Northe northeaste.	θ Southe weste.
K. Northeaste and by northe.	ι Southweste and by weste.
L. Northeaste.	π weste southe weste.
M. Northeaste and by easte.	Σ weste and by southe.

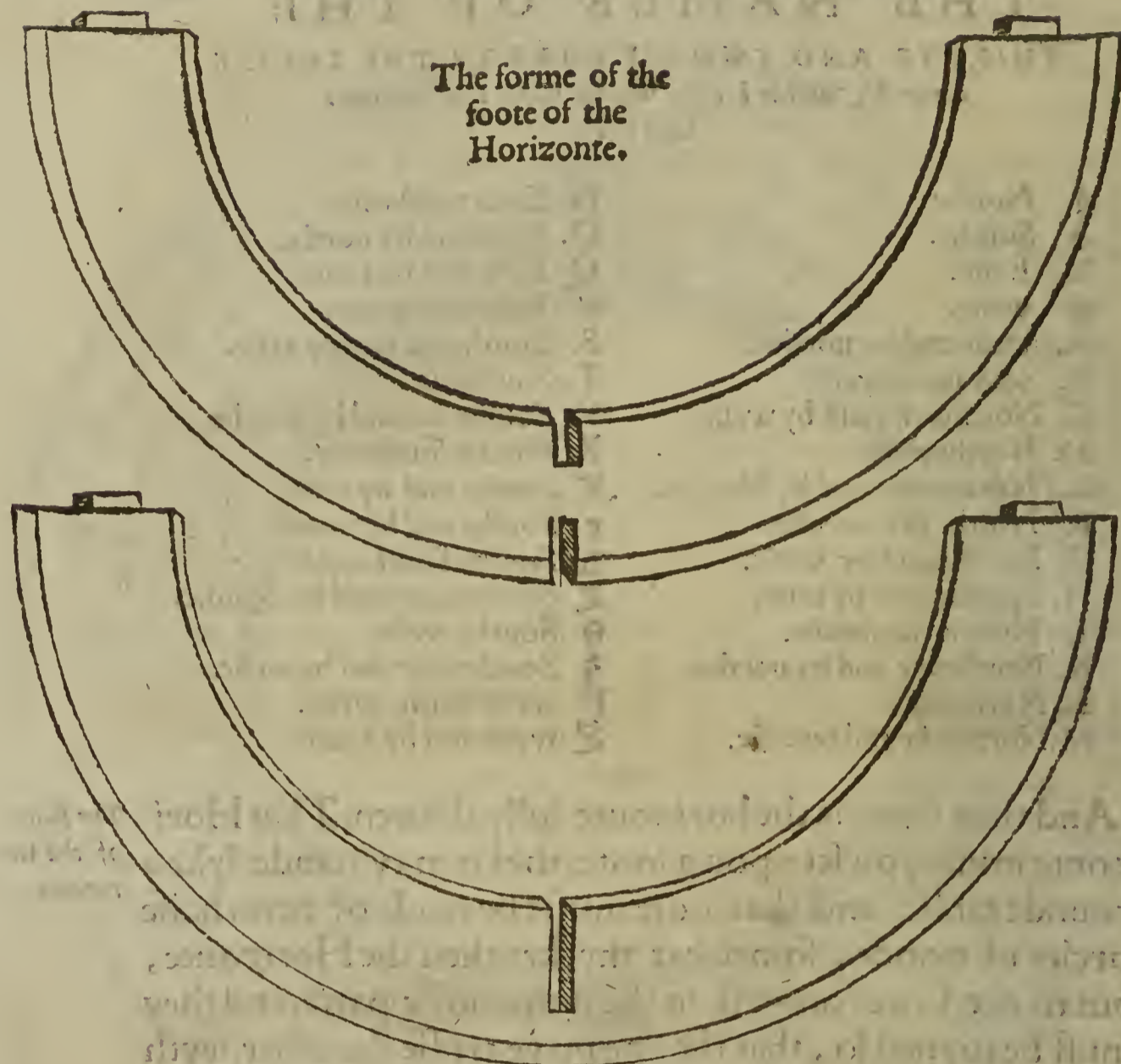
And thus nowe is the horizont fully drawn. That Horizont muste you set vpon a foote, that it may stande lyke a rounde table: and that foote muste be made of twoo halfe circles of woode, somewhat thicke then the Horizont, but of the same compasse in the innermoste parte, and they must be ioyned so, that the one maye crosse the other, wyth ryghte corners, and them selues bee fastened on a stronge foote, that may beare all the whole frame, wyth the Globe. The ioyninge of them ynto the Horizont is diuersly to be ymagined, for if their headdes be flat, then muste you haue nailles or els pinnes, that must perse the Horizont and enter into their heddes; otherwaies there maye be left certaine tenauntes on their heddes, and then must you make lyke mortyses agreable to them, in the Horizont, to receaue those tenauntes, & so may there be ymagined diuers other formes, whiche I leaue to your owne deuise.

Schollar! If I myghte see their forme I shoulde be muche easied in framynge it.

E.ij.

Master

The foote  
of the Horizont.

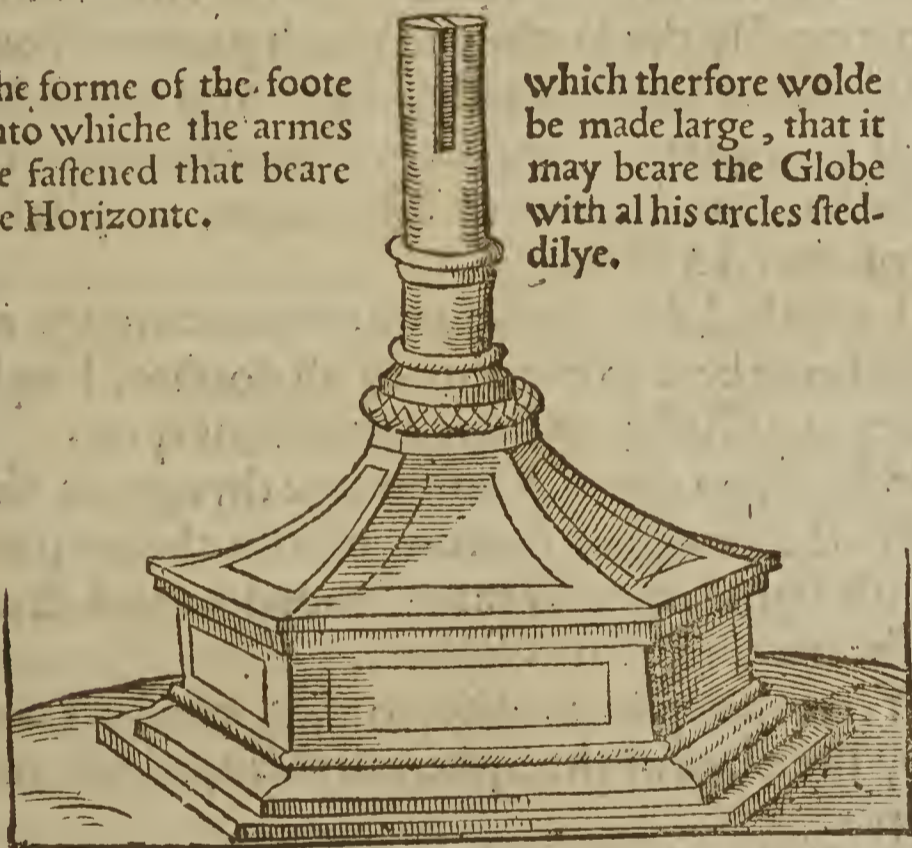


The forme of the  
foote of the  
Horizonte.

Master. Here is the form, with their sockets, & one namely for the Meridiane, in that arme also that goeth from East to weste. Howe be it, it shall be best, to fasten those armes vnder the Horizonte in the Southe easte, Southe weste, Northe easte, and Northe weste, and so shall the Meridiane synke beste into the Horizonte, with an easye socket in the meetinge of those armes, so that the iuste halfe of the Meridiane onely maye appeare aboue the ouer edge of the Horizonte: in whiche thynge practise shall instructe you farther. As for the foote, make it as you thinke beste. But nowe muste you cutte out of bothe, the Meridiane and the Horizonte all that is within the inner-  
moste

moste circle, and so muste you pare awaye all that is without the vttermoste circle, to make them bothe lyke iuste circles. Also you muste make in the Horizonte twoo socketts, one by the Southe lyne, and the other by the Northe lyne, so that the one syde of those socketts whiche is toward the easte, shall touche the Southe and Northe lynes, and the other side shall go westwarde from bothe those lynes, as muche as the thicknes of the Meridian is: and the length of eche of those sockettes shall bee agreable to the iuste breadthe of the Meridiane, so that the Meridiane maye entre iustlye into those socketts, and turne in them without stressynge.

The forme of the foote vnto whiche the armes are fastened that beare the Horizonte.



which therefore wolde be made large, that it may beare the Globe with al his circles stedilye.

Schol. This trobleth me somewhat, because the sockettes be not iustelye one agaynste the other, but bothe stande toward the Weste halfe of the Horizonte.

Master. It wolde trouble you worse to re-

membre that the Globe muste be fastened to the Meridiane on the two poles, & both they placed within the Horizonte.

Schollar. That is straunge in deade, for so shold the globe beare more toward the west, then toward the easte: and so all were misframed.

Master. To auoide all that, you shall make twoo small

E. iij.

clampes.

*The hāging  
of the glob  
in the Me-  
ridiane.*

clampes of thinne brasse plate, and bow them so in the middle, that when they are tacked to the side of the Meridiane in twoo contrarye pointes, iuste ouer that line where 90. is set, thei may receaue in their bought the poles of the globe. I meane here by the poles two shorte pinnes, which shall go through those clampes of brasse, and be fastened or driuen into the twoo Poles of the Globe, excepte you will take the paine to pearse a hole through the globe, from one Pole to the other, for so maye you make an axetree to run thorough bothe the clampes and the whole Globe, whiche is all to one effecte. And by this meanes shall the Globe not onlye hange in the iuste middle of the Horizonte, but also the one side of the Meridian (whiche hathe the diuisions in it) shall pointe exactly the southe and north partes of your Globe, whiche will be moste exactly seene, if you consyder the thicknes of your axetree, and frame youre clampes so, that the one halfe of the thicknes of the axetree, may be let into the syde of the Meridian.

Schollar. I thynke I doo conceaue the true meanyng of your woordes, howe be it to bee oute of all doubt, I wyll be bolde to see your Globe, at some conuenient tyme.

Master. So shall you doo well, for manye thynges in the makinge, and in the vse also of instrumentes, are better perceaued by a lyttle sighte, then by many woordes. and thus haue I ended the making of this Sphere.

Schollar. Yet is this sphere vnylike to that, whiche is commonly vsed, by the name of the Sphere, and is made all together of hoopes.

*The Ar-  
mylle or  
Ringe  
Sphere.*

Master. You shall vnderstand that this is the true sphere, whiche I haue described, and that other (which you meane) ought rather to be called an Armylle or Ringe sphere, then absolutely a sphere, for it is but a part of this other Sphere: I meane, that it doth contayne only the circles of the sphere and not the substaunce of it. And therefore dothe many men cal that a Perfed sphere, and is named in Latin Sphæra per-  
tusa,

rusa, where as they call the other sphere, a Sound or Massye Sphere, that is in latine, Sphæra solida. but seynge that it is not only commonly receaued by the name of the Sphere, but the vse of it is very apte in teaching, and it is more easy to bee made in flyghte forme for yong learners then is the soonde sphere, and for other considerations, whiche nowe I omyt, I wyll also describe the composition of that Armylle sphere. Fyrst you shall make of woode or of brasse (as you lyst to bestow the coste) four hoopes of one bignes in compass, the one of them beyng three times so broade as any of the other, as your eye may ayme. Then diuide eche of those circles into 360. partes, one of them accordynge as you did diuide the Equinoctiall in the former sphere, and the other two lyke vnto the two Colures, and the fourthe which must be the brodest of them, you shall diuide, as you learned to diuide the Zodiake in the other sphere. And when they are thus diuided, you shall call them by the names of those circles whose diuision they folowe, wherefore if the Zodiake haue more breadth then twelue degrees are in lengthe, you shall abate the ouerplus, allowing it but 6. degrees in bredth on eche syde of the Ecliptike line, whiche as you remembre before, did run by the mydle of the Zodiake.

The making  
of the Ring  
sphere.

The equi-  
noctiall.  
ij. Colures.

The zodi-  
ake.

Schollar. Then I perceaue I muste make in this Zodiake an Ecliptike line, and all the signes with their diuisions, as I learned in the other Zodiake.

Master. You shall make them as like as you can deuise. Then shall you ioyne the two Colures so together, that the one of them may crosse the other, (as thei do in the Globe) with righte and equall corners, obseruing well that the places of their crosseing be in the iuste pointes where 90. is set, in eche of them: and those places muste be called the Poles of the sphere. Then put on them bothe crossewaies (like a girdle) the Equinoctiall circle (so that it do crosse them exactly with his middle, in those pointes where the numbere of eche quarter dooth beginne, and that the beginning of the

The Poles.

E.iiij.

Equi-

The .ij. tropi-  
pikes.

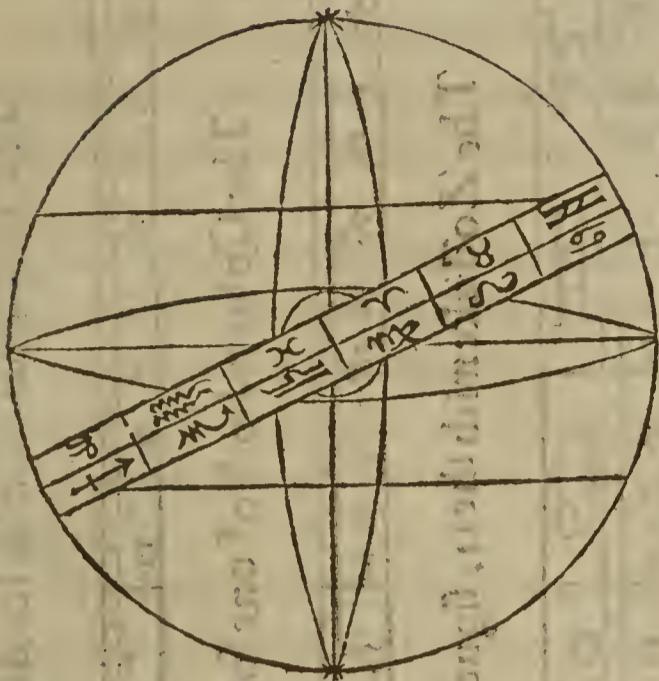
The Arctik  
and Antar-  
tik circles

The Pole  
circles.

The zodi-  
ake.

The Axtr  
The Meri-  
diane and  
Horizonte.

Equinoctiall, in numbre be againste the iuste middle of one of them, that is, of it that standeth for the equinoctiall colure, and then shall the 180. degree of the same Equinoctiall stand iustly on the middle of the same Colure, in the contrarye pointe: and the other Colure whiche is the Tropike Colure, shalbe ioyned with the 90. degree, & the 270. of the equinoctial, in ij. contrary points. Then shal the 2. tropike circles be set on þ Colures equidistantly to the equinoctial, so that thei be fastened on the 23. degree & a half from þ Equinoctial, wherby you may easlye conceaue, that they muste be somewhat lesser then the equinoctiall, that they may ioyne closely to the foure Colures. Then muste you haue twoo other circles of one bygnesse, that may ioyne iustly with the Colures, 52. degrees from the Equinoctiall, on eche part equallye distaunte: and those muste be called the Arctike, and Antarctike circles, or the South circle, & the Northe circle. Beside these you shall make two other lesser circles of equall bygnes, whiche shall be set on the Colures also equidistante frō the other paralleles: and they must be fastened with their middle on the 66. degree & a half frō the equinoctial on both sides, that is 23. degrees & a half from eche pole, and therefore I thinke meetest to call these circles peculiarly, Pole circles. This beinge doone, you haue 2. Colures and 7. Paralleles fixed on them. Nowe muste you sette the Zodiake a slope waies crosse the Equinoctiall, so that his myddle lyne, named the Ecliptyke lyne, maye touche the myddle of eche Tropyke, and that maye you trye by the vtter edges of the breadthe of the Zodiake, for the one muste touche the 29. degree and an halfe, and the other the 17. degree and an halfe from the Equinoctiall. And thus is this sphere plaine-lye made, whose picture I haue here sette, as it will bee drawn in a flatte forme. Then if you make twoo small holes thoroughe bothe the Colures, in the places of theyr crossynge, where the Poles of this Sphere are, and putte a small axc tree thoroughe theym, you maye thereby ioyne



ioyne this Sphere to his Meridiane fyrste, and then place it in the Horizonte, as you didde place the Globe: for those two circles, are like in both these Spheres.

Schollar. I vnderstand all thinges here in wel inough as I thinke, saue þ̃ I doubt somewhat of the quantitye of the parallele circles. for although I know by triall I maye att lengthe make

*The Pro-  
portion of  
the circles  
in a sphere.*

them meete, yet woulde I gladlye knowe their measure before hande, if I myght, for so shall I be sure to worke moste certainly.

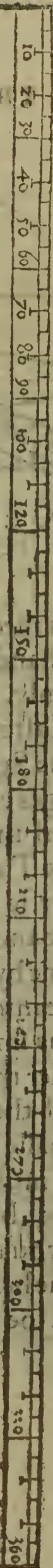
Master. Your desire is good. and all be it that the writers of the Sphere haue omitted it, as they haue doone manye thinges els, yet will I geue you a rate of proportion drawen out of the tables of Cordes and Arkes, called commonly in latine Tabulæ Sinuum.

Fyrste you vnderstand, that the Equinoctiall, the Zodiacke and the two Colures must be of one compasse, that is of one bygnes, althoughe not of one bredthe, for the Zodiacke must be in bredthe twelue degrees, and the other circles as small as they maye be, and beare any stresse, for the smaller they be, the better they are, and moste apte for the vse of the sphere. The other syxe paralleles wold be made as smalle as they maye beare conuenientlye, and in lengthe they muste haue three dyuers rates, whyche I wyll sette forthe, bothe in measure, and also in numbres, to the intent that you may alter the measure to what hignes that you list, by the helpe of the numbres.

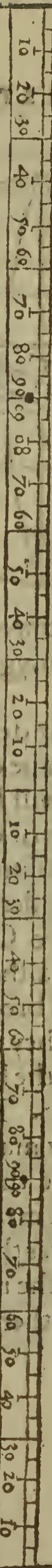
And loe here is there formes.

The

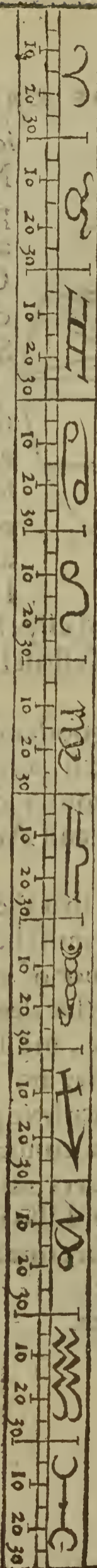
1. The Equinoctial with his diuifion.



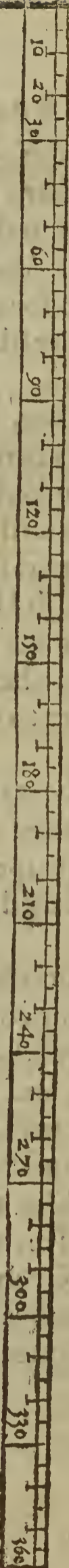
2. The Colures both of one forme.



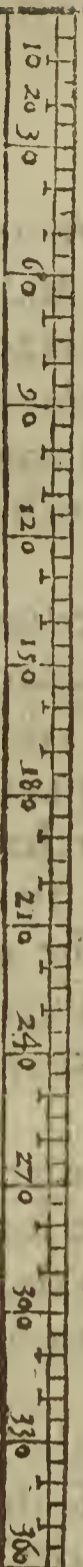
3. The Zodiacke with the 12. signes, and his bredth of 12. degrees.



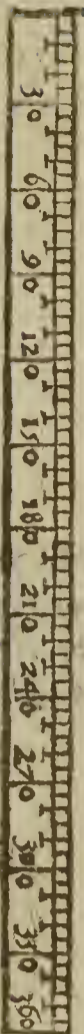
4. The length of the two Tropikes.



5. The proportion of the Arctike and Antarctike circles.



6. The proportiō in length of the two Polare circles.



Here you see sixe severall formes.

The firste representeth the iuste lengthe of that plate or hoope, that shalbe the Equinoctial, and in it is the diuisions sett forth as they ought to succede in ordre, with their numbres agreeablye.

The second is the forme, that serueth for the two Colures with their numbres and diuisions, as thei should be set.

The thirde is the draughte of the Zodiake with his iuste bredth of sixe degrees, and the twelue Signes sett forth with their degrees ordrelly. And these three circles be all of one lengthe.

The fourth circle dothe represent the due lengthe of the two Tropikes, whiche must be shorter then the Equinoctiall by 30 degrees, for it is equall to 330 partes of the same: so that the lengthe of the Tropike dothe beare the same proportion to the Equinoctiall, as 11 doth to 12.

The fyfte plate, relembleth the measure of the circles Arctike and Antarctike, and is in lengthe equall with 222. degrees of the Equinoctiall, which proportion is as 37. to 60.

The sixte plate setteth forth the iuste measure of the two Pole circles, whiche is equall to 144. degrees of the Equinoctiall, and so it beareth to him the same proportion that 2. dothe beare to 5. and eche of those circles Paralleles are diuided lyke vnto the Equinoctiall, into their 360. degrees.

Schollar. This is so plainly sett forthe, and so certenlye, that I see no doubtfulnes now in the whole worke, for the makinge of it: for these plates are so made, as if they were of metalle, and shoulde haue bothe the endes soudred together. so that if any man wil make them of wooden hoopes, he must allow so muche more in the length of eche of them, as will suffice for to bynde them faste in compassed forme.

But these hoopes of this lengthe will make but a very small Sphere, yet by the same forme of the numbres, and their proportion, I may make a sphere of what bignes that I will.

Master. So may you do certenly. and if you will haue a sphere

Sphere twise so much in cōpas as these hoopes wold make, or thrise, or 4. tymes, and so forth; this measure also may serue you, taking for eche circle so often tymes the length of the lyke here in this patron, as you wil haue your Sphere greater then this in nombre of tymes.

Schollar. And so I perceauē, if I woulde make an other three tymes and an halfe so bigge as this, I ought to take the measure of eche circle thre times and an halfe. and so for all other proportions.

Master. Truthe it is, saue that you must augment the breadth of the Zodiake only in like nombre of times; But as for the other circles, they are brod inoughe if they be not to weake, for the smaller they be, the better is the Sphere, syth their breadth dothe serue only for strength, and for to receaue the diuisions as here you see.

And thus haue I described vnto you both sorts of Spheres, that is the Globe or Massye sphere, and the Perled sphere or Armille. One other forme of Sphere there is, whiche excelleth both these formes, and is wonderful apt for the teaching and expresseing of the Theorikes of Planetes, therefore I wyll reserue it to that place.

Here needeth no repetition, bycause all standeth in woorkyng of the former lessons before repeated, and therefore this seconde treatise shall ende here.

THE THIRDE TREATISE, 61  
 WHERIN IS BRIEFLY TAUGHT

*the vse of the Sphere, for certaine conclusions of daily  
 appearaunces and other lyke matters.*

MASTER.



**N**OW YOU LOOKE TO HEARE SOM  
 what of the vse of the Sphere, as you shall  
 do anon: And for an induction therunto,  
 you must diligently knowe the plages of  
 the world, amongst whiche there are four  
 principall, that is, the Easte, the Weste, the  
 Northe and the Southe: and betwene these  
 are there other diuers, which are sufficiently set forth in the  
 Horizont of the Globe, as muche as shall at this time bee  
 needefull.

*The plages  
 of the  
 worlde.*

You must knowe also, that every one of the Paralleles in  
 the heauen hath a lyke circle in the earthe proportionably  
 drawen, and answeringe to those that are in heauen, in iuste  
 rate of distance. So is ther fyrst an equinoctiall in the earthe  
 exactlye drawen vnder that Equinoctiall in heauen, and it  
 diuideth the whole earthe into twoo equall partes, betwene  
 the southe and the northe, so that it poynteth precisely the  
 myddle of the earthe, in that respecte: and all the partes of  
 the earthe from that earthly Equinoctiall toward the north,  
 is called the Northe parte of the earthe: and of the world  
 lykewayes all that is beyond that cyrcle towards the south,  
 is called the Southe partes of the earthe.

*The Paral-  
 leles in the  
 earthe.*

*The earth-  
 ly equino-  
 ctiall.*

*The middle  
 of the earth*

*The northe  
 part of the  
 earthe.*

*The southe  
 parts of the  
 earthe.*

Schollar. Yet wee doo call that parte only Northe, that  
 is northe from vs: and that wee call Southe, that is southe  
 from vs.

Master. You muste consider that there is two formes of  
 speakinge in suche talke, the one vulgare, and commonly  
 vsed, as well of the vnlearned as of the learned, and that ma  
 keth not the comparison to the whole world, which few men

F.i. doth

doth know, but it regardeth principally their owne cuntry, which they do best know. The other talk is general in forme of speakinge, bycause it hath respecte to the whole earthe, and yet is it not generall in knowledge, for fewe men canne aptlye skylle of it: so that bothe are true in their due vse, but the one is lesse knowen then the other.

Schollar. So I perceave then, that although in common talke we do call Spaine southe, and likewise other cuntries, yet is not that true in comparison to the partes of the whole worlde, but in comparison to vs, for our common talke hath chiefe relation in suche thinges to our owne cuntrye. But I pray you then, where is the myddle of the earthe, from whiche we must make our accompt, and vnto whiche we muste haue regarde in all suche generall talke?

Master. That wyll I tell you anone, but firste we muste ende that matter that we beganne withall, touchynge the Paralleles on the earthe, whereof I haue named yet onelye

An example of the Paralleles in earth agreeably  
to the Paralleles in the skye.

The Tropi-  
kes on  
the earthe.



the Equinoctial, but now we must you imagine other 2. parallels next vnto it, the one toward the Southe, & the other toward the north, which maye answer to the 2. Tropiks. And for a general knowledge fyrst, vnderstand this, that at nations ouer whose heds the son doth run directly, whē he is in the hyest point toward the north, he is in the beginning of Cancer, where he describeth the tropik of Cancer in the skie, at those people I saye

saye dwell iust in the course of the like tropike in earth: And contrary waies, all those people ouer whose heddes the Son passeth directly, when he is in the Winter tropike, they dwell in the course of that south Tropike in earthe, and haue the sonne right ouer their heddes that daye that he entreth into the firste degree of Capricorne.

Schollar. By these examples I can imagine the southe and north circles in  $\varphi$  earth to be vnder the Antarctike and Arctike circles in heauen, and so two Polare circles in earthe vnder the two Pole circles in heauen. Then are there seuen Paralleles in earthe, answering to seuen other in the skye.

The other  
Parallele.

Mastr. That is sufficient. howbeit for this time I will omit the circles Arctike & Antarctike, bicause in mine opinion, they make no Zone in earth, though all the Grekes in appearance do say the contrary, but I will bringe inuincible reason for my purpose, when we come to the scanning of repugnant sentences, especially whē I do disagree with the grekes, which are the fathers of witte. but in this pointe of the five Zones, I like much better our own cuntry man Iohn de Sacro bosco as I will now only affirme, & in the fourth treatise wil proue it substantially. Therefore to continew our matter as we began: there are made by these v. paralleles, v. large roomes in the heauen; and other v. in the earthe, agreable to them in heauen; whiche spaces are called Zones.

Ioan. de  
S. Bosco  
zonarū re  
staurator

The fyue  
zones.

Scholl. By your fauour, ther are sixe Zones, if euery space betwene the Paralleles be accompted for one zone, and that doth not only the accompt of the by memorye declare vnto me, but also the sighte of them in this figure; which is commonly named the figure of the Zones.

Example of  
the zones.

Master. Nother doth the accompte deceaue you, nother yet the sight of the figure, but wante of knowledge of their naturall qualities, whiche therefore I will tell you by and by, though these parallele circles do sufficiently distincte them, as their notable boundes, yet by the qualities bee they distincte also. for as reason doth leade you, all the space be-

The quali-  
ties of the  
fyue zones.

F.ij.

twene



tweene the 2. Tropikes, must needes bee esteemed verye hotte, bycause the Sonne runneth alwaies betwene the; so that in the myddle betwene the two Tropiks is þe equinoctial line; frō the which the Son is neuer fully 24. degrees

The Burning zone.

The Frosen zones.

The Temperate zones

so must it seem to be as hotte there in the myddle of winter, as it is in Spaine in the myddle of Sommer, and for this cause all the olde Cosmographers dydde thynke that that countrye myghte not be inhabited for heate: and therefore called all that space betweene the two Tropikes, the Burning Zone, called in latine Zona torrida. And of eche syde of it, they noted two Zones, one vnder eche Pole, whiche they called the Frosen zones, (and are named in latine, Zonæ Frigidæ) where for extreme cold, they thought that no man might dwell. and betweene those Frosen zones, & the Burning zone, they appointed two Temperat zones, (called Zonæ temperatæ of latine men) which were partakers of the heat on the one side, and of the cold on the other side, so that of bothe, there was made a temperate mixture.

Now se you that betwene the Equinoctiall and the one tropike, there is no other qualitie, then is betwene the same equinoctiall and the other tropike, wherfore all men (except only Polybius) did accompt the space betwene the Tropikes but as one Zone: so that the Equinoctiall is the bounde of no Zone, but passeth by the middle of the Burning zone.

Schollar. Nowe I see (as I haue had at other tymes often occasion) þe we learn many things when we be childrē, which we vnderstande not all when we bee menne, for by this talke

I remem-

I remember that both in Ouide & Vergile I learned þ̄ distinction of those 5. Zones, but what was to be vnderstande by them, I neuer knewe till now. And nowe I see reason that betwene the 2. Tropikes, all may well be accompted the Burning Zone, where no man can dwell, as bothe my authors affirme.

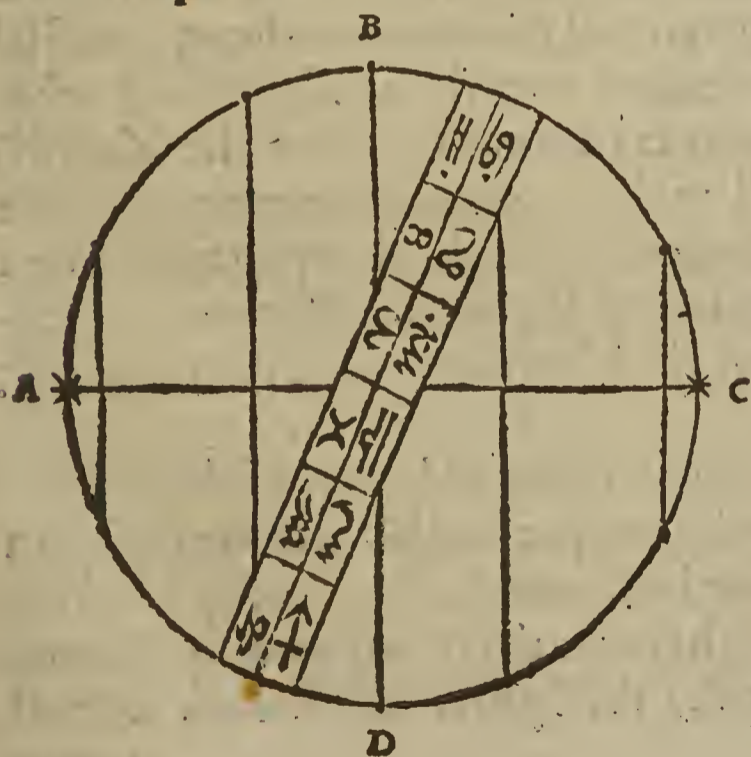
Master. They had spoken more modestly, yf they had said that ther had been painful dwelling for heat. & likwaies of the cold Zones, þ̄ ther is hard dwelling for cold: but of this wil I more exactly reaso in an other place, and for this time (as þ̄ truth by experience is knowen) I suppose that all þ̄ 5. Zones haue their inhabitants, though not so plentifully as the two Temperat zones now haue, especially this tēperat zone that we dwell in. Who is it that hath not hearde of the isles of Molucca, and of Samatra, where the Portingales gette the greate plentye of riche drugges and fine spices: and all that haue been there, confesse that those places ar right vnder the Equinoctiall line: and Calecut is but little from it, for it is

A.C. The Horizonte.

B. The pointe ouer the heade.

\*. The Poles of the worlde.

The Zodiake and the other circles doth appeare of them selfe.



more thē 19. degrees beyond the Tropike of Cācer toward þ̄ south so þ̄ it is within 5. degrees of the very equinoctial line. Now therefore I thinke it moste apt place for my purpose to begin at these cūtries, ouer whose hed the equinoctiall dothe rightly passe, so þ̄ they muste nedes see both þ̄ Poles in their Horizonte.

Sc. That doth reasonably folow, bicause half

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the

the heauen iustly appeareth aboue the Horizont, and the other halfe is vnder the Horizont. And also I perceauē that if I set the sphere so that the Equinoctiall stand full vprighte, then will bothe the Poles be in the very Horizonte. as this position of the Sphere doth shewe.

*A ryghte  
Sphere.*

Master. You consider it righte. And bicause the Equinoctiall doth crosse the Horizont with right angles (for all 4. angles are equall) therfore is this placing of the sphere called a Righte sphere: so that all other nations, whiche haue the one Pole aboue their Horizonte, must needes haue the other Pole vnder their Horizonte, and the Equinoctiall declineth from the point right ouer their heddes, that waye as the hidden Pole is, whether it be toward the South, or els toward the Northe.

*The vse of  
the materi-  
all sphere.*

Schollar. All this seemeth easie to me, as longe as I beholde this materiall sphere: but when I doo not conferre it wyth your woordes, then your saynges appeare the more doubtfull.

*The Zenith*

*A bowing  
Sphere.*

Master. For that cause did I teache you the making of it, before I instructed you in the vse of it, knowing how greate a helpe the sighte of the eye doth minister to the righte and speedye vnderstandyng of that, whiche the eare doth heare. But againe to our matter: in all places where the equinoctiall doth decline from the pointe ouer the heddes of any inhabitants (whiche pointe is commonly called the Zenith) there the Equinoctiall maketh vnequall corners with the Horizont, and therfore is that called a Bowying sphere, or a Leanyng sphere, bycause the Equinoctiall boweth or lea- neth toward one syde of the Horizont, more then toward the other side.

Schollar. I haue hearde it called a Crooked sphere also.

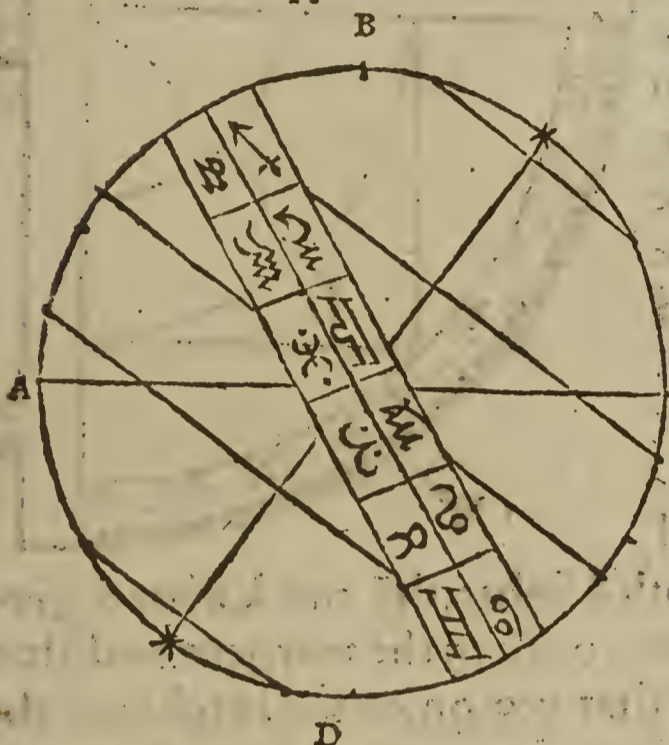
Master. That name is vnapt for this arte, for there can bee no crooked corner betweene the Equinoctiall and the Horizonte, which myght make that name meet for the matter: and (as I haue sayde) the Sphere taketh those seuerall names

A.C. The Horizonte.

B. The Zenith.

\*. The Poles.

The Zodiacke, the Equinoctiall and the other circles do appeare of them selfe.



names of his diuers position, and accordyng to the corners that the equinoctiall doth make with the Horizonte.

And this may you consider herein, that there is no Zone but one that canne haue a right Sphere: and to speake precisely, but one tracte in that zone, whiche is the very middle of the Burninge zone, righte vnder the Equinoctiall whereas there be innumerable places & haue Leaning spheres, whiche

you may call Oblique spheres or Declining spheres, if you delite more in latinelyke names then englishe.

Schollar. So I perceauie that bothe we and all other nations whiche dwell not righte vnder the Equinoctiall lyne, muste be named to haue a Leaning sphere. And this I consider resonably, that in some cuntries the sphere dothe leane and bowe more then it dothe in other, whiche difference I wolde gladly vnderstande.

Master. The diuersitye in leaning of any sphere, is agreeable to the eleuation of the Pole in euerye cuntrye, so that where the Pole is hyghest aboue the Horizonte, there the sphere leaneth most: and where the Pole is lower and nearer to the grounde, there the sphere leaneth lesser.

Schollar. Howe shall I iudge truly the height of the Pole?

The height  
of the Pole

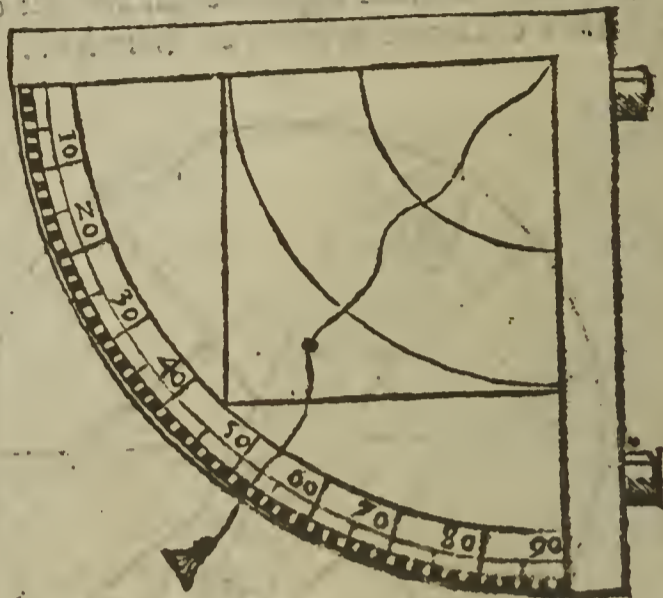
Master. That true and exacte iudgement will I not treat of as now, to auoide interruption in teaching: it shall be sufficient for this place to shewe you a plaine and easye forme,

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with

with the vse of an instrument that may helpe you sumwhat in marking the height of the Sonne and Moone and anye other starres that you lyst. and the manner of it is thus.

You shall take a Quadrante (whose composition I haue taught amōgst other instruments in the Gate of knowledge, but this which you se here, is the forme of the moste playnest sorte) and by the twoo syghtes of it, you shall marke the height of the Northe starre commonly called the Pole; and



when you se it through both syghts, the mark what degree the lyne of the plōmet doth touch in the margent, and, that may you call Latitude of that region, or the height of the Pole, for this tyme and place where no precisenes is required. for nowe it is sufficiente for you to vnderstande generallye, that there are suche diuersities of eleuation of the Pole in diuers countries: and thereby maye you vnderstande, that all Spheres bee not alyke in theyr position. As for example. In the southe partes of Englande aboute Sowthampton, the Pole is not fullye 51. degrees hyghe, and in the isles of Orkenaye, beyonde Scotlande, the Pole is aboue 62. degrees highe: this maye easilye bee tryed by them that list to trauayle, but if you lyst to go no farther then Yorke, you shall fynde the eleuation aboue 54. degrees, and so at Edynburghe shall you fynde the eleuation aboute 57. degrees. And thus within your owne cuntrye maye you vnderstande a greate diuersitye, wherby you may coniecture the diuersities that bee in other partes of the worlde.

Southham-  
pton.

Yorke.

Edynburgh

Schollar. This is so apperaunte to them that will trauel any thing for knowledges sake, that they cā not pretend any

any ignoraunce, but wilfull ignorance: but herein I fynde one doubt, that maketh me to muse, for in trauelyng thus from one place to an other, whereby the Pole is diuerslye chaunged in his eleuation, I can not thinke that the Pole it selfe dothe chaunge his place, but that rather the Horizont doth alter, from which we muste take the measure of height of the Pole.

*The alteration of the Horizont*

Master. You say well, for in deed there is no suche motion in heauen, that maye make the Pole so notably to chaunge his place: but as we doo chaunge our standinge, so dooth there appear a newe Horizont, whiche causeth the Pole to seeme higher: if we go towarde the northe, for then wee see more of the skye (that waies) aboue our Horizont, then we did see before: but if we go toward the South, then will the Pole seeme lower and lower, still as we go Southward: not bycause the Pole chaungeth, but our Horizont chaungeth: for nowe wee see more of the skye towarde the Southe, and lesse towarde the Northe: but yet generally as much as wee leese in the one parte, so muche wee wyne in the other coaste, so that euermore we may see halfe the skye.

Schollar. Then this is my doubt, how I shal vnderstand your former woordes: for I remembre you sayd that the Horizont was a circle immouable, and did not turne as the circles in heauen do: & now you haue plainly declared that the Horizont dothe chaunge, whiche can not be without mouinge of it.

*Whether the Horizont do moue or not.*

Master. You haue answered your owne question, if you marke it well: for the Horizont moueth not as the circles in heauen do moue: that is to say, it goeth not round about the earth by a daily course, but it standeth steddye whyle the heauen moueth, so that if you neuer chaunge your place, your Horizont will neuer moue. And to speake more exactly: the Horizont moueth not, though you moue neuer so farre: but rather should we saye, that you are come into an other Horizont, when you are come into an other countrye.

cuntrie.

Schollar. It muste needes appeare so, nowe that I do consider the matter more earnestly: for when I am at London, I see the same Horizonte that all other men there do see: then if I go to Yorke, I see the Horizont of Yorke, and not of London, so that the Horizont of London remaineth as it was, and so doth the Horizont of Yorke, whether I carry or go. And thus I perceave great alteration in the Horizonts betwene southe and northe, wherby the pole is diuersly altered in height aboue the Horizont. What if I go eastward or westward, shall I not fynde the lyke alteration?

Example of  
Calecut.

Master. It must needes appeare yes. for the same reason that causeth you to chaunge your Horizont betwene south and north, the same will cause it to chaunge betwene east and weste. And for declaration thereof, answere me to this question: Do you thinke that there is any suche cuntry farre east from vs, as the Portingales reporte Calecut to be?

Schollar. It were as muche folly to make a doubte of it, as it were to make a doubte of Babylon, or Hierusalem.

Master. And do you thinke that the sonne doth rise to vs and to them at one tyme?

Schollar. It can not be. for this muche I maye gether by that I haue learned already, that the rising of the sonne, and of all other starres, is the apearing of them aboue the Horizonte, so that they rise to vs, when they beginne to appeare aboue our Horizont: and they rise to them in Calecut, whē they appeare aboue their Horizonte. And further I gether now by your brieve admonition of the chaunge of the Horizontes, that as betwene southe & northe in our owne cuntry, we maye perceave notable diuersitie, so maye wee consider y<sup>e</sup> same much more in so greata distaunce, as Calecut is noted to be from vs, which I haue heard to be named aboue 15000. myles, and that is farre greater (yea 20. tymes) then all the lengthe of Englande and Scotlande together. wherefore I gather that the diuersities of the Horizontes must be  
twenty

twenty times so much, as was betwene Southhampton and the northe parte of England.

Master. The distaunce is not so much, nor the difference so great, but by meanes that the Portingales do saile a meruailous compasse in goynge thether, they accompte the distaunce by that compassed course, whiche is farre from oure talke now, for we must euer take right distaunce by a straight line, as often as we do speake of any such matter. how be it for examles sake, suppose it to be. 6000. miles east from vs, it seemeth to be more then a quarter of the whole compasse of all the earthe, (as I will proue it in the nexte treatise) and therfore must the Sonne at the leaste rise 6. houres to them soner then it dothe to vs. do you perceaue that?

*The diuersities of the day in diuers Regions.*

A.C. The Horizonte of London.

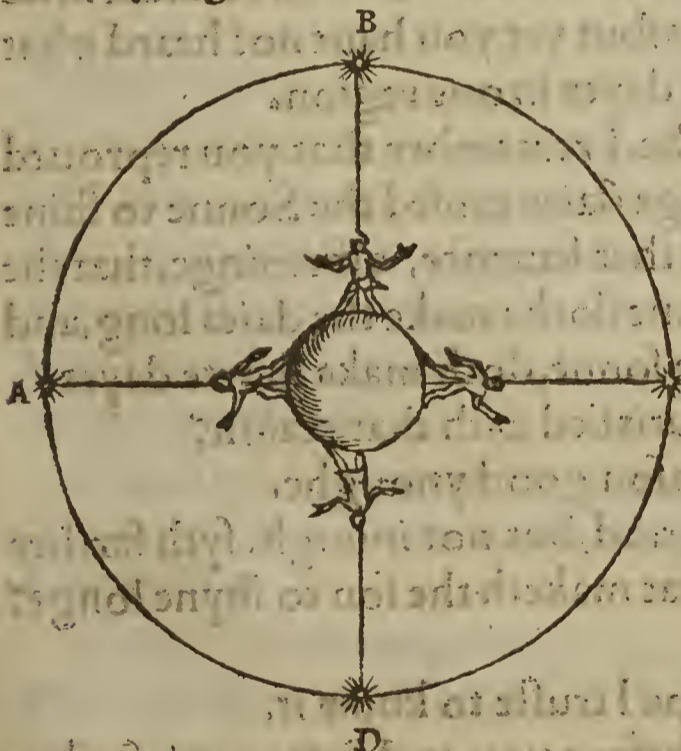
B. The Meridian of it.

A. The easse to London, and the nonesteede to Calecut.

D.B. The Horizonte to Calecut.

D. The easse to Calecut, and the line of mydnyghte to London.

C. The weste to London, and the lyne of mydnyghte to Calecut.



Molucca doo, must needes see the sonne before them: and those

Schollar. The Son (as all men knoweth) doth compasse all the earthe in 24. houres, then muste it compas halfe the earthe in 12. houres, and a quarter of the earthe in 6. houers. this is as plaine as can be: the it must needes folow, that if they bee a quarter of the earthe more toward the east then we, they must see the Son 6. houres sooner then wee.

Master. And likewise they that dwell farther east then thei, as the inhabitantes of

those that dwell more westerly then they do, as at Hierusalem, or at Constantinople, must haue the daye springe later then they that be at Calecut. And thus you maye consider, that the Horizontes doo chaunge as well betweene east and weste, as it dothe betwene southe and northe: As this figure sheweth for London and Calecut.

Schollar. That is plaine. for if all those places had one Horizonte, then should the sonne rise to them all at ones.

Master. And as their morninges do differ, so must their noonetyde differ also.

Schollar. No man that hath reason can denye that.

Master. Then muste their Meridian circles differ in lyke sorte, seeynge they be the limites of the nonetide.

Schollar. So I perceauie that betweene east and weste, the Meridianes do chaunge, as well as the Horizontes: and hereby I vnderstande, that when it is sonne risinge at Calecut, it is not day with vs, by 6. houres: and when it is noone with them, it is 6. of clocke in the mornynge with vs. and so of all other houres, whiche all appeareth by the former figure.

*The diuersities of daies in one Region.*

Master. This standeth for the declaration of diuersities of dayes in diuers regions: but yet you haue not heard what causeth the diuersities of dayes in one region.

Schollar. Yes for sooth. I remembre that you reprobued me for saying that the longe daies caused the Sonne to shine longe: and you tourned that sentence, affirminge, that the longe shynynge of the sonne dothe make the daies long, and the shorte shynynge of the sonne, doth make shorte dayes.

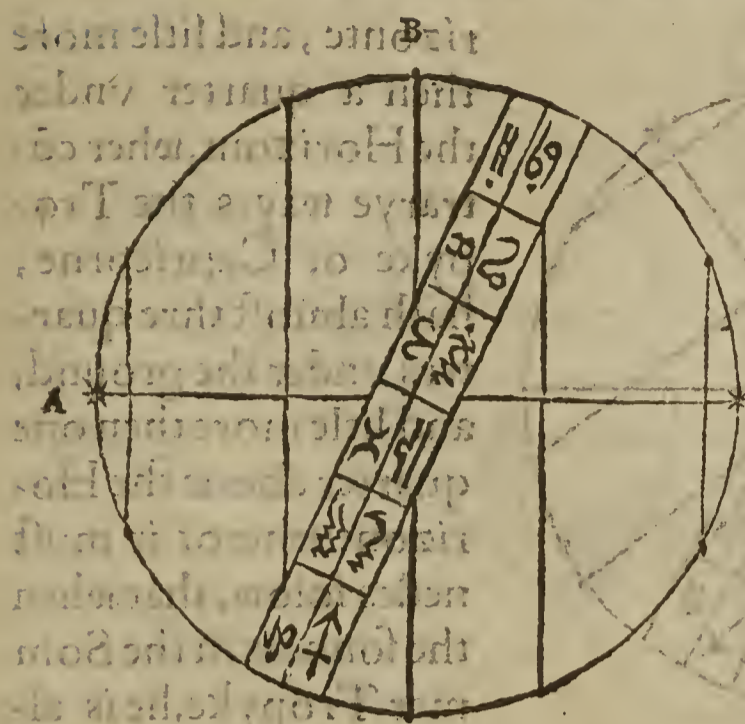
Master. And are you satisfied with that reason?

Schollar. I thinke it reason good ynoughe.

Master. The reason is good, but not inough, syth farther reason is to be giuen. What maketh the son to shyne longe? can you tell?

Schollar. By your helpe I truste to know it.

Mastr. Set your Sphere before you, and first turn it so that  
both



bothe the Poles may touch the Horizōt, which is the situation of the right Sphere. Then do you se<sup>p</sup> the horizōt doth cut not only the equinoctiall circle in 2. equall halues, but lykewayes doth it cut bothe the tropikes, equally into 2. euen partes, so that there is as much of eche of them a-

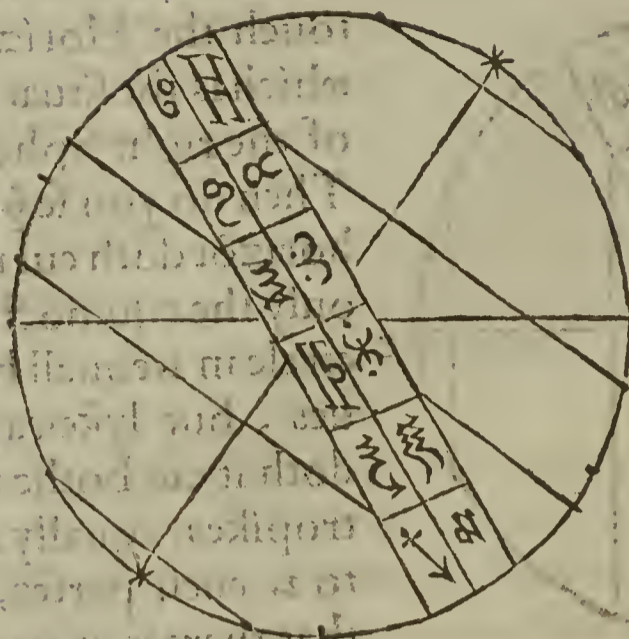
boue grounde, as there is beneth the Horizonte: and contrarye waies. Wherefore it muste needes appeare, that the son when he runneth in anye of those three circles, is lyke tyme aboue the Horizont, as he is vnder it, so must the daies and the nyghts be equall, not only when the son is in the equinoctiall circle, but also when he is in any of the both tropykes: but this equalitye of dayes and nyghtes, when the sonne is in any tropike, is priuately appropriated to the ryght sphere: for in all other varieties of the Bowinge spheres, then is the greatestte difference in all the yeare, betweene the day and the nyghte, when the sonne is in any of the tropikes: as for example: Set the sphere to what eleuation that you lyst. that is to saye: Raife the Pole as many degrees aboue the Horizonte as you will.

Schollar. I haue sette it nowe (as heere you see) to the eleuation of 52. degrees, whiche you saye is the eleuation at Cambridge.

Master. And nowe maye you see that the Equinoctiall onelye is equallye dyuided by the Horizonte, and that the twoo Tropikes are verye vnequallye diuyded, so that the tropike of Cancer hath almost thre quarters aboue the Ho-

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rizont



rizonte, and litle more then a quarter vnder the Horizont, wher contrarye wayes the Tropicke of Capricorne, hath almost thre quarters vnder the ground, and litle more then one quarter aboue the Horizont: wherof it must nedes folow, that when the sonne is in the Sommer Tropicke, he is almoste thre quarters of

the Naturall daye aboue grounde, and lyttle more then one quarter of the same daye vnder grounde.

A Naturall  
Daye.

Schollar. I knowe your mynde very well, and I doo gather thereby, that when the daye is at the longest, it is almost 18. howers daye, and but lytte more then six howers nyghte. And contrarye waies in the shortest of winter, the daye is lyttle more then sixe howers longe, and the nyghte almoste 18. howers. And farther I heare you call the whole space of 24. howers a Naturall daye: But I know not yet the reason of that name.

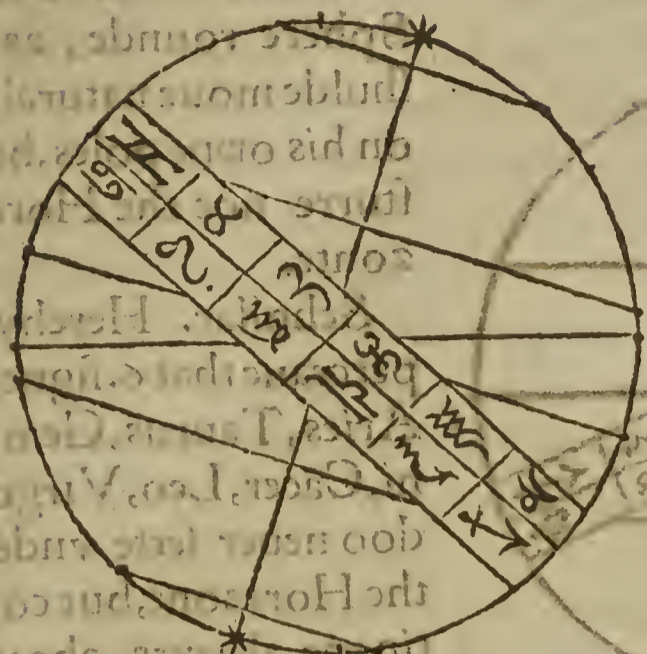
An Artifi-  
ciall Daye.

Master. By that name of addition, the whole daye of 24. howers is distincte from the Artificiall daye, which is from sonne rysinge to sonne settinge: and that Artificiall daye is moste commonlye vnderstande, when men speake of the daye, therefore for a difference it is good to vse suche an addition. But nowe for the better practise, let your globe to some other eleuation.

Schollar. I trow I haue set the pole highe ynoughe.

Master. Let it stande. What is the numbre of the eleuation?

Schollar. I do see betwene the Pole and the Horizont in the Meri-



Meridian dyuers num-  
bres, but I take that num-  
bre onli, which touchith  
the horizon, and I take  
that also of the twoo or-  
ders of numbres, which  
descendeth from þ Pole,  
and that is here now 71.

Master. That is the  
latitude or eleuation of  
the Pole at Wardhouse;  
where our newe vente-  
terers into Moscouia  
do touch in theyr viage:

but now mark the varietie of the tropiks to the Horizont:  
The Tropike of Cancer is (as you see) more then foure de-  
grees aboue the Horizont cleare, so that the whole 2. signes  
of Gemini and Cancer, with 5. degrees of Taurus, and as  
muche of Leo, doth neuer sette vnder the Horizont.

Schollar. Then while the sonne is goyng through those  
signes, from the 25. degree of Taurus, to the 6. degree of  
Leo, it is continuall daye, bicause the sonne doth not set vn-  
der their Horizont, but I pray you how long tyme is that?

Master. It is from the 7. day of May vntill the 19. daye of  
Iuly, so that it is continuall day with them by the space of 73

The longest  
Daye at  
Wardhous  
is 73. daies  
continuall.

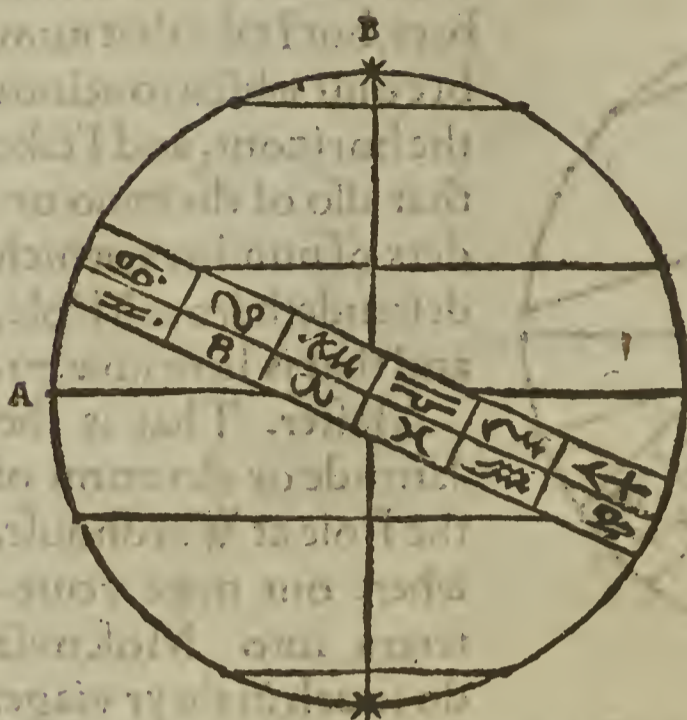
Schollar. This is meruailous straunge to me.  
Master. Yet shall you hear more strang matter then that:  
Sette your Sphere so, that the Equinoctiall maye be iustlye  
in the Horizont, and the north Pole righte vp in the place  
of the Zenith.

Schollar. That haue I doone, as here you maye see.  
Master. Nowe marke how muche of the Zodiake dothe  
neuer go vnder that Horizont.

Schollar. Howe shall I perceauē that?

G.ñ.

Master.



Master. Turne the Sphere rounde, as it shulde moue naturally on his owne poles, but sturre not the Horizonte.

Schollar. Hereby I perceau that 6. signes, Aries, Taurus, Gemini, Căcer, Leo, Virgo, doo neuer sette vnder the Horizont, but continewe alwayes aboue it.

Master. Then while the sonne is in those fixe signes, he can not bee out of theyr syghte, that dwell within that Horizonte.

Schollar. It is truthe, yf any body doo dwell directly vnder the Pole.

Master. It is not now my purpose, to prooue what partes of the earthe be inhabited, (for that appertaineth to Geographye) but to declare howe the sonne doth shewe in all partes of the worlde, as well on the sea, as on the londe: and as well in wyldrenes, as in populous cuntryes. Whereby it doothe appeare sufficientlye, that vnder the Poles of the worlde, it is halfe a yeare continuall daye, and the other halfe yeare, continuall nyghte, bicause so longe againe the Sonne is not seene aboue that Horizonte.

The length  
of the daye  
vnder the  
Poles of the  
worlde.

The excel-  
lencye of  
knowledg.

Schollar. This is as true as canne bee. the reason of it is so certayne and manifeste, that I could not better vnderstande the state of that place, if I were there to see it, then I doo by thys beholdynge of the Sphere, and the motion of it. And thys (as I take it) is a meruaylous excellencye in knowledge, to bee able so certaynly to iudge of thinges absente, as if they were present: to bee able to tell

what

what houre of the daye it is in all the partes of the earthe, and when the Sonne ryseth and setteth in all nations vnder heauen.

Master. Yow wolde accompt this knowledge more meruelous, if you vnderstoode other more wonderfull conclusions in it, whiche hereafter I will vtter as I shall haue occasion conuenient: but in the meane season, I will shewe you two or three conclusions, appertaining to our presente matter whiche we haue in hande.

As the houres of the daye are dyuers in dyuers regions, so the shadowes that the sonne causeth in their dialles, and all other shadowes, doth disagree many waies, not only from our shadowes, but also one of them from an other. Againe the times of the yeare are not alyke through all the worlde, but when it is Sommer to vs, it is winter to som other: and when it is Springe time with vs, it is sommer in an other cuntrye: and when it is Haruest with vs, other people haue sommer: so when it is Winter with vs, som nations haue sommer: yea when the spring time beginneth with vs, it is haruest in some cuntries, and in other cuntries it is midsommer at the same time: but when it is midsomer with vs, it is haruest no where in the worlde, but midde winter it is then in two diuers partes of the worlde.

Schollar. This talke is meruailous, and in mine opinion the greatest meruaile is, & you can vnderstand the shadowes of their dials or any other thinges, in all partes of the world.

Master. Peraduenture it wold seem more merueilous if I shoulde say, that by the knowledge of the shadow of a staffe, or any thing els that standeth vpright, (if I heare it trulye reported) I will tell you in what part of the worlde that shadowe was marked. And thinke you this no meruell, to tarry within Englande, and yet to measure all the compasse of the earthe, as certenly, as any man can do it, by going rounde about the earthe.

Schollar. These thinges do excede credit, saue that other  
G.ij. thinges

thinges, whiche before I iudged impossible, and now I know them certenly, do perswade me to thinke many thinges possible by learning, that seeme vnpossible to the ignoraunte, thoughc their wittes be neuer so good. I heare suche men say sometimes, that learned men and farre trauelers may be permitted to talke at their pleasure, syth no man canne controll them.

Thre conclusions.

Master. By those woordes they signifie, that they do not credite all that learned men do write or saye: wherfore I will constantly saye to them, that if they wolde vouchsafe to imploye somtyme in learninge, they shoulde be easilye perswaded, not onely to beleue suche thinges as nowe they thynke impossible, but also to know them so certenly, as they know howe many fingers they haue. But to perswade you in the meane ceason, I will presently shew you some of these thre conclusions before named, I meane for the generall knowledge of the times of the year: for the declining of shadowes in diuers nations: and for the ordre to measure the whole earthe, and yet go not out of England.

Schollar. If I maye vnderstande but the generall forme of those three, I will trust hereafter to attayne all the reste more certenly.

Master. I will begin with the laste, whiche seemeth moste hardest, and I wyll allcage nothings, but that whiche you shall graunt vnto.

The declaration of the fyrste conclusion for measuringe of the whole earthe.

Schollar. Then shall your prooffe bee as certaine as I can wishe.

Master. Can you with a Quadrante marke the eleuation of the Pole aboue the Horizonte?

Schollar. That is easye inoughe.

Master. Then marke it fyrste at Southampton, or in some other more easterlye place, on the south shore of England. after that go to Newcastle beyond Yorke, and there take the eleuation with your Quadrante againe, and marke it well, and the difference of those two eleuations shall you set

set in your tables, and by it you shall write the numb're of myles diligently and truly taken betwene those two places, where you toke those two eleuations.

Schollar. This can I doo with diligence, although it bee as harde to marke the myles truly (the reportes of them being so diuers) as it is to worke truly with the Quadrante, but diligence will auoide errour in them bothe.

Master. Then go forward to Edynburghe in Scotland, and marke the eleuation there: lykewayes go to the moste northerlye pointe of Catnesse, and take the eleuation there also, alwaies marking the difference of euerye twoo places in myles of equall quantitie, and also the difference of the degrees of the Pole in eche of those places from other, and set them in your tables in ordre the one by the other, as here for examples sake only, I haue set them.

The places.	The Eleuation of the Pole.	The difference in degrees.	The distaunce in myles.
Southampton.	51. 0.	0. 0.	000.
Newecastell.	55. 0.	4. 0.	240.
Edynburghe.	57. 0.	2. 0.	120.
Catnesse pointe.	62. 0.	9. 0.	300.
The summe of all		11. 0.	660.

Here you see for Southampton, where the fyrste eleuation was taken, no myles sette, bicause it is the beginning of your iourneye, but the eleuation of the Pole there is 51. degrees: then at Newecastell the heighte of the Pole is 55. degrees, and that is more then the other by foure degrees, so that foure degrees muste be set downe for their difference in degrees, and their distaunce in equall myles, is 240. Nowe to see howe many myles dothe answere to a degree, I do diuide 240. by 4. and the quotient will be 60. wherfore I saye,

G. iiii. that

that 60. miles in earthe (by this triall) doth answere to one degree in heauen. Then at Edynburghe I finde the eleuatiō of the Pole to be 57, that is twoo degrees more then it was at Newcastle, and the distaunce betweene them in myles, is 120, whiche if I dyuide by 2, the quotient will be 60. as it was before: so that one of these workes doth confirme the other, bicause they agre so iustly.

Schollar. I vnderstande all this, as by declaringe of the thirde woork it shall appeare to you. At Catnesse pointe, the Pole is 62. degrees aboue the Horizont, whiche maketh 5. degrees more then it was at Edenburghe, and the space betwene those two places is 300. myles: now if I diuide 300. by five, there will amounte 60, whiche quotient doth agree with the other twoo before found: so it appeareth that in all Englande, 60. mile in earthe, answereth to a degree of latitude in the skye.

Master. Prooue you also the whole difference in degrees with the whole distaunce in myles.

Schollar. The whole difference in degrees betwene Southampton (where the Pole is 51. degree highe) and Catnesse pointe, (where the latitude is 62.) dothe amount vnto 11. degrees, and the distance in myles is 660: nowe diuidyng 660. by 11, the quotient appeareth 60. agreably as it was in all the other woorkes.

Master. What if you dyd go farther northe, 19. degrees moare? I meane so farre Northe that the Pole were 51. degrees hyghe aboue the Horizonte, howe manye myles thynke you woulde that place be from Southe hampton.

Schollar. That can I quickly accompt by the Golden rule of proportion. The difference betwene those 2. places in degrees is 30. then seyng I found before, that 11. degrees gaue 660. myles, I sette the numbres thus in their forme of woork, and then I multiplie

$$\begin{array}{r}
 660 \\
 \times 30 \\
 \hline
 19800 \\
 \times 8 \\
 \hline
 52800 \\
 \times 10 \\
 \hline
 66000 \\
 \hline
 198000
 \end{array}$$

$$\begin{array}{r}
 660. \\
 \times 30 \\
 \hline
 19800
 \end{array}$$

multiply 660 by 30, whercof cometh 19800 : whiche I must diuide by 11, and the quotient wyll be 1800.

Master. Thynke you thys a true woorke?

Schollar. This woorke is true and without any doubt, so that the measure of myles in Englande were true, whiche wee take for our grounde.

Master. And if that measure bee not true, yet by that manner of woorkynge you maye attayne to a very true rate of myles betwene southe Hampton and Carnesse.

Schollar. That is no greate matter, nother so harde to bee doone.

Master. And it is no greater matter, in bothe those places to take the altitude of the Pole.

Schollar. That is true also.

Master. So that if this rate be not true, ther may be found a true rate by diligence.

Schollar. Yea surely.

Master. And by that true rate you could fynde how manye myles dothe answere to 30. degrees in the skye.

Schollar. Easilye.

Master. Well then: Take this for a true rate, tyll you can fynde an other more certaine. And nowe answere me: How manye myles are in compasse roude about the whole earth?

Schollar. Nay that is impossible for me to discusse yett, tyll I haue farther knowledge.

Master. Se how easye a thing seemeth impossible to you.

Howe manye degrees is there in the compasse of the whole skye?

Schollar. That can I certenlye say to be 360: for as I learned before, a degree is no standynge measure, but a rate of proportion, and dothe betoken the 360. parte of anye circle.

Master. You saye well. Now if the whole circumference of heauen be 360. degrees, I demaunde of you, howe manye myles doth answere to 360. degrees?

Schollar. That maye I doo as in the former woorke, settinge

tynge

The cōpas  
of the hole  
earthe.

$$\begin{array}{r} 1800 \\ 360 \\ \hline 108000 \\ 54 \\ \hline 648000 \end{array}$$

$$\begin{array}{r} 648000(21600 \\ 333 \end{array}$$

ting the numbres according  
to the rule of proportion.  $\frac{30}{360} \propto \frac{1800}{Z}$

Then multiplying 1800, by  
360, there ryseth 648000, whyche I muste  
diuide by 30, and so the quotiente wyll bee  
21600, whereby I knowe that 21600 myles,  
doothe answere vnto 360. degrees in the  
skye. And so it shoulde seeme that those  
are the iuste numbres of myles aboute the  
earthe.

Master. You neede to make no doubte thereof, excepte  
you doubt whether there be any part of the earthe without  
the circuite of heauen: or els that you doubt, whether the  
earthe be in the middle of the worlde.

Schollar. The fyrste doubte were to foolishhe, and for the  
seconde (all bee it I doubte nothinge of it) yet I adsure my  
selfe by your promise, of the full prooffe thereof in the next  
treatise.

Master. And other doubte there canne be none, but this:  
Whether the earthe and the skye bee bothe rounde. whyche  
both I wyll so substantially proue vnto you, that no reaso-  
nable man will doubt of it.

Schollar. Then am I certified in the possibilitie of  
the mooste doubtfull conclusion of the three, whiche you  
proponed: It maye please you to proceede to the other two.

The decla-  
ration of  
the seconde  
conclusion,  
for declinīg  
of shadowes

Master. You do consider that this conclusion being true,  
they that dwell 5400 myles from vs, doo dwell a quarter of  
the earthe from vs.

Schollar. That muste needes be so: for four times 5400  
doth make the whole circuite of 21600. miles.

Mastr. And so they ꝑ dwel frō vs any māner of way, 10800  
miles, thei dwel half the cōpas of the whole earthe frō vs.

Scholar. It foloweth so by the former reason.

Master. It is well known by the nauygations of the  
Portingales and Spaniardes, that there is almost south frō

vs

vs, certain places inhabited about 6300. myles, as namelye at the streight of Magellanus. Also at the great forelonde of Affrike, commonly called the cape of Good hope, are there diuers regions replenished with inhabitantes, and they be from vs southwarde about 5200. myles: then northward wee haue good knowledge of dyuers cuntries beyonde vs about 1200. myles, whiche bothe ioyned together, do make from the greate forelonde of Affrike aforesaid in the south, vnto Wardehouse in the northe parte of Norwaye, about 6400. myles, whiche is more then a quarter of the compas of the earthe: but from Wardhouse to Magellanus streight, it is about 7500. myles, by which distaunce of myles, you maye easilye gether how many degrees of the heauen eche of those places is from vs, and from the Equinoctiall.

Magellanus  
streight.  
The cape  
of Good  
hope.

Schollar. Therein I praye you, that I maye prooue my newe cunninge. The cape of Good hope is from vs southwarde 5200. myles, that is in degrees of the skye  $86\frac{2}{3}$ , accordinge to the former rate of 60 myles to eche degree. from whiche numbre of  $86\frac{2}{3}$ , if I abate so many degrees as we be northe of the Equinoctiall, which are 52 degrees, then doth there reste  $34\frac{2}{3}$  degrees.

So that it appeareth hereby, that the sayd forelonde is  $34\frac{2}{3}$  degrees southe beyonde the Equinoctiall.

Master. Now for Magellanus streight, prooue the lyke woorke.

Schollar. It is 6300. myles southwarde from vs: then by the rule of proportion, agreablye to the former rate, it must yelde in degrees 105, oute of whiche abatying our distaunce northe from the equinoctiall, (whiche is 52 degrees) and so remaineth 53. degrees. thereby I vnderstand, that they are so far beyond the Equinoctiall southwarde. Now will I prooue for Wardehouse, how farre it is northe from the Equinoctiall. It is from vs towarde the

northe

northe 1200. myles, whiche must yelde in degrees, after our former rate 20, from these 20. degrees I maye not abate 52. degrees for our latitude, as I dyd before.

60  
1200 Z<sup>1</sup>

Master. It were againste reason, feynge that the latitude of Wardhouse is greater then our latitude is, and lyeth on the same coaste of the Equinoctiall: for in the former examples the two places were on the contrarye coaste of the Equinoctiall from vs.

1200  
60 (20)

Schollar. I see it well now, so that by reason I must needes adde it to our eleuation, and so ther amounteth 72. degrees, whiche is one degree more then you did affirme it to haue in latitude, in your former declaration.

Master. The cause is this: that rate of 60 myles to eche degree doth serue in goyng precisely from southe to north, but nother is Wardhouse iust northe from vs, but somewhat towarde the easte. nother yet in the other two examples any of bothe places was directly southe from vs, for the Forelonde of Affrike beareth towarde the easte, and the Streight of Magellanus bendeth towarde the weste, yet for this tyme it maye serue as well for our purpose, as if it were more precisely doone.

An ordre in  
teachinge.

Schollar. Yet I thinke in teaching there shoulde bee vsed nothinge but certaine truthe.

Master. What so euer is taught to be retained for a truth, oughte to be a very certaine truth in deede: and they do not well that in suche manner doo teache fyrste vntruthes for truthes. but where inductiō is made by examples, it is often tymes more or at the leaste, no lesse expedient to vse examples not exactly true, then to take only precise true examples, for thereby it appeareth the prooffe to bee of greater force, if it will procede in an example whiche is not precisely true. And in these examples we haue so large scope of triall, that we neede not sticke for two or thre degrees, for I intende not to speake particularly of any citye that is vnder

one

one certain degree, but of whole prouinces, whiche occupieth diuers degrees in their latitude: as you vnderstand that the whole isle of Britayne doth occupy from 51 degrees, vnto 62, which containeth 11 degrees. But now to come to our purpose: thus much you vnderstand, & beyond the equinoctiall, yea and beyond the tropike of Capricorne also, there be inhabitantes.

Schollar. Yea that ther be, aboue 29 degrees besouth the tropike of Capricorne: for that tropike is but 23 degrees and a half beyond the equinoctiall: and ther be inhabitants 53. degrees beyond the equinoctiall, as before is shewed.

Master. Well if there dwell men but 6 degrees besouth the tropike of Capricorn (for I sayde before, I would not sticke with you for a few degrees, sith I wold make my prooffe the more forceable) then I demaund of you, whiche way dooth the sonne stande from them at noonetide?

Schollar. It must needes be alwaies northe from them at noone, as it is alwaies southe from vs at noone, seynge they are beyonde the southe Tropike, towarde the Southe, as we are beyonde the north Tropike towarde the northe.

Master. Then consider two places that stande iuste south and northe (bicause you like well a precisenes in examples) as Venice that famous citie standeth north almost from the cape of Good hope: Now consider the matter thus: in these two places there is one common meridiene line, sith they do stand almost iuste southe and north the one from the other: then when the sonne is in the Meridiene line of Venice, is hee not also in the Meridiene lyne to them that dwell at the sayd Cape of Affrike?

Schollar. Yes trulye.

Master. Then those twoo places haue their noone tydes at one hower.

Schollar. So haue they.

Master. And at Venice theyr shaddowe goeth alwaies at noone toward the north & neuer toward the southe, bicause

H.i.

it is

it is far north from the northerly tropike, called the tropike of Cancer, and so is the foresaid cape of Affrike far southe, beyonde the southe tropike, whiche is the tropike of Capricorne: wherefore (as you haue confessed) their shaddowe at noone tyde, must needes go all tymes of the yeare toward the southe.

Schollar, So I see that those two places haue a contrarye propertye, touchinge their shaddowes.

Master. That is parte of the thinge that I did intende to shewe vnto you: but yet they bothe do agree in this pointe, that all tymes of the yeare their feuerall shaddowes do incline toward one coaste.

Schollar. That is true. for at Venice it goeth stil north, and at the cape of Good hope, it runneth alwayes southe.

ἑτερόσκιοι  
Heteroskij  
Single sha-  
dowed.

Master. These sort of people are named of the greke Cosmographers ἑτερόσκιοι, Heteroskij, bicause their shaddowes goeth styll toward one coaste.

Schollar. As though there were other people, whose shaddowes did sometime go southward, and other tymes northward: I meane their shaddowes at noone, for els all nations haue in one daye, at diuers houres, much diuersitye in theyr shaddowes.

Master. Ye vnderstand the time well, and you shal perceiue as wel, that ther be such places, which chaung their shadows. You confesse that men dwel beyond the tropike of Capricorne southward: and other you know to dwel beyonde the tropike of Cancer northward: & thinke you it not agreable to reason, that betwene these two peoples there do dwell diuers nations in so greate a plotte of ground?

Schollar. I thinke yes. and I heare saye, by our owne cuntrye men, whiche trauaile to Guinea, that they wente beyonde the sonne, whiche alwaies I tooke to be a lye of libertye permitted to farre trauelers, but now I perceauie it maye be true in one sense.

Master. Ther are 2. places of that name, and both are beyonde

yond the tropike of Cancer, toward the south, and the one of them is almoste directlye vnder the Equinoctiall circle: and bicause you haue named that cuntry whiche our nation doothe well knowe, take it for your example. They of Guinea beeyngē nyghe vnder the Equinoctiall, haue the Sonne some tymes northe from them at noone, as when he is in the tropike of Cancer: and other tymes they haue the Sonne southe from them, when hee is in the Tropike of Capricorne. and muste not their shaddowes chaunge in lyke sortes.

Schollar. It can not otherwaies be. And so I see, that when it is midsommer with vs, then doth their shadows go south ward, to as many as dwell betwene bothe the Tropikes: and in our myd winter, their shaddowes goeth northward.

Master. Those people are named of the greekes ἀμφίσκιος, *ἀμφίσκιος*  
Amphiscij, bicause the noone shadows goeth both wayes, *Amphiscij*  
sothe and northe. *Double sha*  
*dowed.*

Schollar. And farther I gather, that there is no quarter in the Horizont, but their shadowe runneth that waies som tyme in the yeare.

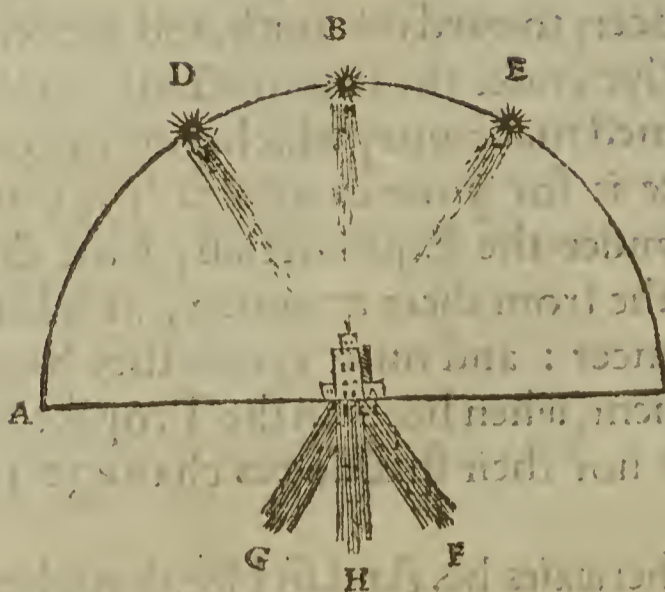
Master. You say truthe. but the chief regarde is here gyuen to the shadowe at nonetide, wherby you may conceaue, that sometime they haue almoste no shaddowe: for when the Sonne at noone is righte ouer their headdes, then theyr shaddowe is ryghte vnder theyr feete, and not on anye syde.

Schollar. It muste needes be so. for seeynge the Sonne is some tymes northe of them, and sometymes southe from them, hee muste needes twyse in the yeare bee right ouer their headdes, ones in going southward, and againe in comynge northwarde.

Master. To helpe your memory and coniecture take this figure for a presidente and example, where I haue set the line A. C. for the horizont, and D. B. E. for diuers places of the son at noone. Now if you call A. the north point of the hori-

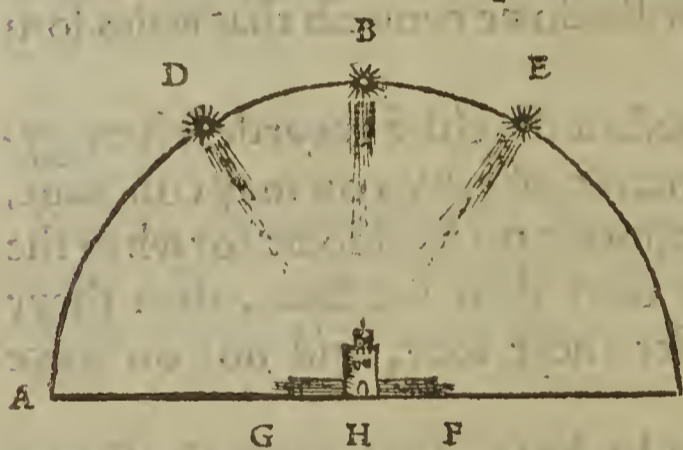
H.ij.

zonte



zonte, and C. the south  
pointe, then when the  
son is in D. toward the  
north from their heds,  
their shaddow goith to  
F. toward þ south. And  
when the sonne is in E.  
toward the southe, then  
is their shaddowe in G.  
bēdig toward þ north:  
likewaies the sonne be-  
ing right ouer their heddes in B, their shaddow must rest in  
H. ryghte vnder their feete. but I see by your countenance þ  
your mind woorketh in some straung imagination: and I  
coniecture it to bee for that I haue drawn the shaddowes  
beneth the Horizonte, as you take it.

Schollar. You haue truly coniectured my phantasye.  
Master. Bicause this place serueth not to declare conclu-



sions of bye matters, I  
wyll exhybite to you  
this other figure, where  
the shaddowes doo run  
on the Horizonte, a-  
greablye to your phan-  
tasye, the letters of  
demonstration remay-  
ninge as they were beefore, and bothe these tende to one  
ende.

Schollar. But heere are but two shadowes.

Master. Where wolde you haue the third set?

Schollar. Right vnder the tower that giueth the shaddow.

Master. But it may not reache from the foot of the tower,  
nother toward one coaste, nor other.

Schollar. No, that it maye not.

Master

Master. Then the foote of the tower doth couer it so, that you can see no shaddow at all.

Schollar. That is most certaine.

Master. Yet remaineth ther an other sort of people, which differ in one pointe from these other twoo sortes, by reason that their shadowe in one daye runneth round about them, and goeth toward all coastes of the horizon: wherefore the Greekes do call them *περίσκιος*, Periscij.

Schollar. Is ther no english nor latin names for these sorts of properties?

Master. The latin men borrowed of the grekes, both their knowledge and also many names of arte, bicause there is not the lyke grace of facilitie in composition, in the latyne tonge, as there is in the greeke tongue, and therefore haue I geuen them no englishe names, bicause no one woorde can aptly expres these properties, excepte I woulde triflinglye make suche an imitation, to call theym, One shaddowes Two shaddowes, and Round shaddows: or els, which is not muche vnlyke, ye may call them Single shadowed, Double shadowed, and Round shadowed.

Schollar. That imitation seemeth straunge. yet were it better to make new english names, then to lacke words: therefore I will not refuse to vse them, till I can learn more apt names. but I praye you, where do those men dwell, that haue their shaddowes runnyng so about them?

Master. Within the Polare circles, for all people whose zenith is within 23 degrees and a halfe of anye of bothe the Poles, haue their shaddowes running rounde aboute them. but as I shewed you before, the nearer they dwell vnder the Pole, the longer is theyr daye: and therefore the oftener doothe theyr shaddowes runne about them. for where the daye is but 24 houres longe, there the shaddowe runneth but ones aboute: and where it is halfe a yeare longe, there it runneth aboute 193 tymes: and in all other meane places raccodingly.

H. iij.

Schollar.

*περίσκιος*  
Periscij.  
rounde shadowed.

Schollar. This is manifest ynoughe by your former declaration of the lengthe of the dayes, and the course of the sonne. And farther I perceaue that when they that be vnder the Northe pole haue their shadowes thus runninge aboute them, then they that dwell vnder the Southe pole haue no shadowes at all, for it is continuall darkenes with them.

Lighte and  
Darknes  
vnder the  
Poles

Master. You saye well, concerninge the sonne lyght, touching them that dwell directly vnder the Poles, but yet they haue the lyghte of the Moone euery moneth more then 14. dayes together.

Schollar. Then do they not wante lyghte (thoughe they lacke the sonne) but only halfe a moneth together, when the Moone is in that halfe of the Zodiake, which is out of their Horizonte.

Master. That is well considered of you. And yet euerye moneth they lacke not lyghte, thoughe bothe the sonne and the Moone also bee oute of their sighte: for as you see with vs, that we haue lyghte before the sonne rising, and after the sonne setting, so haue they suche a lyghte by the beames of the Sonne 50 dayes continuallye after they haue losse the sighte of the sonne, and so haue they the like lighte 50. daies continuall, before the sonne doth rise to them.

Schollar. Then they wante not the sonne lyght but only 82. daies, although they see not the sonne in halfe a year, and yet halfe that 82. daies they haue the mone in their sighte, as I perceaue by your former lessons: for seing she goeth about the Zodiake euerye moneth, she must needes bee halfe that tyme in that parte of the Zodiake whiche is alwaies about their Horizonte. This contemplation deliteth me muche, to marke places absente, as if I were present, and to see their alterations by reason more certainly, then I can do by sense, if I were there presently.

Master. Yet will I withdrawe you from this matter, tyll an other more conuenient place: and now will I procede to the thirde conclusion mentioned before: that is the generall know-

knowledge of the times of the year, in all parts of the world. When the sonne is at the highest with vs, it is at the lowest with diuers other nations, namelye to all them that dwell other vnder the Equinoctiall circle directly, other southe from it: and therefore all those nations haue mydde winter, when wee haue midde sommer. But amongst them all there is one region, whiche is as farre beyonde the equinoctiall towarde the southe, as we are towarde the northe.

The thirde  
conclusion  
is declared.

Schollar. That region is about Magellanus streight, as I gether by the seconde former conclusion.

Master. In deede the streight of Magellanus is in that region, for here I meane by a Region that whiche the Grekes do call a Climate, whiche is in forme lyke to those Zones, whiche I did describe before, saue that there are more suche Climates or regions, then there are Zones: for the climates may well be accompted 48 betwene the twoo polare circles, whiche containeth but three of the Zones. but of those climats I will say no more at this present, but that euery regio where the longest day is half an hour longer or shorter then it is in anye other region, must bee accompted in a seuerall climate from it: so that vnder the equinoctiall the longest daye is but 12. houres, and with vs in the myddle of Englande, it is about 18. houres: wherefore we must accompt that the myddle of Englande is in the 12. clymate from the Equinoctiall northwarde, and they that dwell 66. degrees and a halfe north, or southe from the Equinoctiall, bicause their longest day is of 24. houres, that is twelue howers longer, then it is in the myddle of the worlde vnder the Equinoctiall (from which all those accomptes of Climates do begin) they must be iudged in the 24. Climate.

A Climate.

The nōber  
of climates

Schollar. Then are there 24. climates on eche syde of the Equinoctiall, betwene it and the polare circles, yet I remembre that the common authors make mention but only of 7. on either side, whiche maketh but 14. in all.

Master. That shalbe answered anone, where I will set out

H.iiij.

the

The quali-  
ties of con-  
trary cli-  
mates.

the ordre and reason of the diuersity of the climates: but for this time it shall suffice that you consider this, that all places within one Climate, haue the tymes of the yeare alyke exactly, and their dayes styll of lyke quantitie the one to the other, and they that dwell in the contrarye climate, as many degres on the other side of the Equinoctial, thei haue bothe the times of the yeare contrary, and also the quantity of the daies disagreeable. for when it is sommer in the one climate, it is winter in the other: and when the daye in the one dothe increase, the nighte in the other dothe increase after the same quantitie iuste.

Schollar. Then for example: In the cuntrye about Magellanus streighte, it is sommer when wee haue winter: and when our daye is at the longest then is their nyghte at the longest.

Euery Cli-  
mate hath  
4 quarters

Master. Trueth it is. and when wee haue springe, then is their haruest: and so is it common to all them that dwell aboue the earth within those twoo climates, yet is there this difference, that in our climate and theirs also we maye imagine four quarters equally distincte: the firste quarter being that which we dwell in, and in the contrary climate, our meridian circle limiteth the first quarter, & also the third quarter in both places, so that in this first quarter in both climates, the times of the day and night ar a like: for when it is noone to vs, it is noone to them: and when it is midnight to them, it is midnight also to vs.

Schollar. Then likewise when the sonne riseth to them, it riseth to vs, and so setteth at one time in bothe Climates.

Master. Ye are far deceiued, for then of necessitie muste it folow, that their daye and ours at one time should be of one quantity, which is not true, as I said before: but the reason of that shalbe shewed anon. yet is it true, that their houres agre with our houres, if their meridian circle agre with ours. And the same meridian circle ynder ground doth limite in both these climates, the 3 quarter also, wher it is noone when we in

the

the fyrst quarter haue mydnyght, and they haue mydnight at our noone. Now may you easlye conceaue by your owne mynd, the places of the other two quarters.

Schollar. Ordre inforceth them, the one to be in our west, and the other to be in our easte.

Master. That distinction is sufficiente for you at this time, and it is precisely true, if you meane the easte, where the Sonne ryseth at the begynninge of the Sprynge tyme; or of the haruest; wherfore for that time I wyll make myne example: When the sonne riseth to vs in the spring tyme, it is noone with them that dwell aboute Calecut, and when the son is in our Meridian line, then doth he set to them: so that whē the son doth set to vs, it is midnight to them about Ca  
lecut, & thē is it noone to the famous cuntry of Peru: Again  
at that time the son riseth to thē that be in the isles of Moluc  
ca. wherby you may gether that Peru & Calecut be in 2. con-  
trarye coastes of the earthe, and therfore seeme to go wyth  
their feet the one against the other, and their heddes the one  
fromwarde the other, whiche sorte of people therefore are  
called of the Greeks and Latines also *ἀντιπόδες*, Antipodes,  
as you myght say Counterfooted, or Counterpassers. Now  
to our purpose. all people that haue mydnight when other  
haue noone, doo differ in sonder by halfe the compas of the  
heauens, one waye: yet may they not be called Antipodes,  
except they differ in distaunce euerye waye a quarter of the  
skye, and must haue one meridian circle. So that our Anti-  
podes must be vnder our meridian circle, and must be halfe  
the compas of that circle from vs.

Calecut.

Peru.

Molucca.

Antipodes.

Schollar. Then as wee are 52. degrees northe from the Equinoctiall, so muste they bee 52. degrees southe from the Equinoctiall, in that parte of the Meridian circle, whiche is vnder oure Horizonte, and then haue they mydde-nyghte when wee haue noone: and hereby I perceaue that they haue mydde nyghte when it is noone at Magellanus streighte.

Master.

Antipodes.

Master. In deede it is daye then at Magellanus streight, but not nighe noone, for Magellanus streight is muche to farre toward our weste: but for examples sake that erreure maye be permitted, and especially bicause there is no lond but sea, where you shoulde meane that noone to bee: so can you giue it no propre name: but retaininge that name for example of the true place, you may consider three sortes of people, that is to saye, our selues, and those that dwell by east Magellanus streight, vnder our Meridian circle, which haue noone when we haue noone, and the thirde sorte which are vnder the same Meridian, but haue midnichte when we haue noone, and are as farre southe from the Equinoctiall, as we are northe, whome I named our Antipodes, and so ought they to be called in respect to vs, and we are Antipodes to theym also: But nowe comparinge theym with those other by east Magellanus straight, they are called eche to other *periceci*, as you may saye, lyke dwellers, bicause they dwell vnder one Meridiane circle, and vnder one Parallele also, and be like in distaunce from the equinoctiall circle.

Periceci,  
likedwellers

Schollar. There are manye places in euerye suche region or climate, but there are but two proprely vnder one Meridiane, and the one of them hath midnichte when the other hath noone: so the tymes of the daye doth differ with them yet I perceaue that they haue the seasons of the yeaere agreeable, bicause they dwell on one side of the equinoctiall. Then must it folowe that those whiche vnto vs be Periceci, are Antipodes to them that dwell by Magellanus streight vnder our Meridian.

Antichthones,  
Counterdwellers.

Master. You saye well. and we vnto them by east Magellanus streight, vnder our Meridiane, are called by the greekes and latines *αντιχθονες* Antichthones, as you wold say Counterdwellers, or Counterclimates.

And thus haue you three sortes of inhabitauntes by comparing the one with the other, wherof alwaies Periceci (that

is

is Likedwellers) haue like tymes of the yeare, but not of the daye. Antichthones or Counterdwellers, haue like times of the day, but not of the year. Antipodes or Counterpasers, haue nother the parts of the year, nother of the day agreeable together, but cōtrary in both, how be it ther is a farther cōsideration for exactnes of this knowledg, which I will herafter declare to you in place more conuenient: but hereby maye you gather the diuersities of tymes of the yeare, and also of the dayes, accordinge to the diuersitie of the inhabitauntes comparinge them all other to your owne cuntrye, or one of them to an other, as occasion shall serue, and oportunitie of matter. And thus will I ende for this time, if I maye perceauce by your repetition of this thyrde treatise that you remembre all thinges therein declared.

Schollar. I were els to blame. but as I haue learned in it manye seuerall thinges, so for the ordre of the arte these I note as chiefe matters.

- 1 Firste the distinction of the Plages of the worlde, accordingly as they be sette forthe in the Horizont of the Sphere.
- 2 Then the Paralleles on earthe, agreeable to the Paralleles in the skye, of like names, and distaunce proportionable.
- 3 Thirdly the distinction of the .v. Zones, by their qualities and limites, and of their inhabitantes.
- 4 The diuersities of Spheres according to their diuerse inclinations, but twoo are the generall distinctions, that is a Ryght Sphere, and a Bowinge Sphere.
- 5 Fyftlye, you gaue me a brefe ordre to take the heyghte of the Pole, or any other Starre or Planete.
- 6 Then folowed the diuers alterations of the Horizonte, as wel betwene Easte and weste, as betweene Southe and Northe.
- 7 Seuenthye, there was declared the causes of the diuersities of the daies, fyrste in diuerse regions, and then in one region.
- 8 The difference betwene a Naturalle daye, and an Artificiall daye.
- 9 The quantitie of the longeste daye in certen partes of the worlde, and namely vnder the Poles of the worlde.
- 10 How by this excellent Arte a man maye measure all the compasse of the earthe, and yet abyde styll in one cuntrey.
- 11 A distinction of sondrye inhabitantes, accordinge to the diuersities of their shaddowes, whiche are three principallie.
- 12 Then lastlye folowed an other distinction of inhabitantes, accordinge

*The repeti-  
tion of the  
thirde trea-  
tise.*

to the agreeablenes and diuersities of tymes of the yeare, and the quarters of the daye, and these you named by three seuerall names also, whiche are names of comparifon, bicause they take not those names, but in comparifon to other nations.

This I remembre to be the summe of this laste treatise.

Master. You remembre it well, and vnderstande it also well, as it may appeare by your repetition. Therfore now shall you depart for a time, and you shall reade ouer againe your authors of the Sphere, whiche you did name before, and now marke whether you can vnderstande them, and at your returne, I will instruct you more exactly in all the premisses, and other diuers conclusions, whiche now I haue omitted of purpose.

Schollar. I am moste earnestly bound vnto you for your great gentlenes, whiche I pray god to requite, sith I cannot, and who wyll els I knowe not.

Master. Farewell then, and remembre your owne profit.

Schollar. The author of all profite, continew

and increase your profit, that you may

haue quiete time to trauaile for the

profite of manye.

THE FOUETH TREATISE OF 97  
THE CASTLE OF KNOWLEDGE

WHEREIN ARE THE PROOFES OF ALL

*that is taught before, and other diuers notable conclusi  
ons annexed therto, but nothing in a manner with  
out demonstration and good prooffe.*

SCHOLLAR.



IF THE INEXPLICABLE BENEFITE  
of knowledge did not enforce me to for-  
gette all bashfulnes, I myghte thinke it to  
muche shame, so often to trouble my  
Master frome his earnest studies, and to  
staye him from his profitable trauell with  
mine importune crauyng of knowledge,

namelye sithe I canne not recompence anye parte of hys  
paynes: yet hys gentlenes is suche, that hee seeketh more  
the profite of other, then his owne pleasure or peculiare  
commoditie: and therefore will I boldly entre into his house.  
Are you at home syr?

Master. I am alwaies at home for my friendes, if I bee not  
with them from home: yet some times I can not be at home  
for my selfe.

Schollar. The lesse for me and suche as I am, that often  
trouble you more for our owne commoditie, then for  
your gayne.

Master. I seeke to gaine no more then competentelye  
maye serue my necessarye vses, with conueniente regarde  
to my charges: but if I offende anye wayes in couetinge  
monnye, I adsure you it is to beare the charges in set-  
ting forth such monumentes of knowledg, as were meruai-  
lous profitable for all men, very pleasant to many men, & yet  
estemed only of wise men. but sith I cā not do the good that  
I wold, and other want will which haue goodes in excesse, I  
must do as many other doth, wish good to all men, & helpe  
I.i. them

them as I canne. And for your parte I looke none other recompense but this, that you alwayes be thankfull to your Master. and as hee helpeth you freelye, so doo you healpe other againe, and hyde not the knowledge priuately, whiche may profite many publikely. but now to your matter: haue you perused the authors of the Sphere which are commonly readde?

Schollar. To reade them all, it were to muche for my lyfe tyme, and the profite not so greate, as I heare manye menne saye: for as the noumbre are infinite, so the latter wryters doo mooste commonlye but repete that, that twoo or three of the auncientes haue written before. wherefore as I learned that the beste wryters of them for my studye, were Proclus, Ioannes de Sacro bosco, and Orontius the Frenche man, so I haue readde them, and out of them haue I collected a table of theyr mooste notable matters, whyche as yet I vnderstande not, or els doo desyre to heare the demonstrations for their prooffe.

Master. You haue doone well in bothe pointes. for as the numbre of writers are infinite, so haue I founde great tedious payne in readinge a greate multitude of them. Notwithstanding as you shall hereafter seeke further knowledge, so muste you reade more wryters in that matter: wherefore amongst a greate noumbre woorthye the readinge, I wyll name a fewe vnto you, whyche I wishe you to studye: and the resydue I leaue to your owne discretion. Cleomedes the greeke authour, is very woorthye to bee often readde: but beste in hys owne tongue, for the latine booke is muche corrupted. Also Euclide his booke entituled Phaenomena, and Stoffler his commentaries vpon Proclus Sphere: whyche booke I wishe were well recognised (as it hathe greate neede) then myghte it serue in steede of a greate numbre of other bookes. Dyuers Englyshe menne haue written right well in that argument: as Grosched, Michell Scotte, Batecombe, Baconthorpe, and

and other dyuers, but fewe of their booke are printed as yet, therefore I will staye at those three for this tyme. As for Plinye, Hyginus, Aratus, and a greate manye other, are to bee readde onlye of masters in suche arte, that can iudge the chaffe from the corne. and Ptolemye that worthy writer and myracle in nature, is to harde for younge schollars, except they be fyrste instructed not onlye in the principles of the Sphere, but also well traded in Euclides his Geometrye, and also well exercised in the Theorykes of the Planetes. But nowe let me see the table that you haue collected.

- 1 The ordre and mouinges of the nine Spheres.
- 2 The spaces of their reuolutions by their propre motions.
- 3 The forme of heauen is rounde, and his mouynges circularc.
- 4 The earthe is rounde in forme, and the water also.
- 5 The earthe is in the myddle and Centre of the worlde, and is but as a pointe in comparison to the Firmamente, and doth not moue anye waies.
- 6 The compasse of the earthe, and the diameter of it, what they make in common myles.
- 7 Of the circles in heauen what is theyr iuste quantityes, their numbre, their ordre, their distaunce, and their offices.
- 8 Whye the Zodiacke hath that name, and whether anye suche formes bee in the skye.
- 9 The diuers significations of a figure, and the declyninge of them. There are two Horizontes, one sensible, and the other onelye iudged by reason, and what the quantities of them bothe are.
- 10 The Greekes and the Latines doo not agree in the description of the circles Arctike and Antarktike, and what are theyr reasons.
- 11 Whether there bee anye dwellers in the Vntemperate Zones.
- 12 What bee the circles Verticall and circles of Heighte, the circles of howers, and of the twelue houses.
- 13 Of the ryfinge and settinge of the Signes and other Starres, bothe in the Ryghte sphere, and also in the Bowing sphere, after the Astronomers.
- 14 Of the Latitude of the Sonne and the twelue Signes from the east and weste.
- 15 Of the risinge and settinge of the starres, after the mynd of the poetes.
- 16 Of the diuersitie of Naturall daies, as well as of Artificiall daies in diuers partes of the earthe.
- 17 The diuersities of howers, wherof some are equall, and other vnequall

- accordinge to the course of the sonne.
- 18 The heighte of the sonne aboue the Horizonte at all howers, and in all regions.
  - 19 The diuersities of shadowes, wherof some be called Ryght shadowes, and other be called Turned shadowes.
  - 20 The distinction of the circles Paralleles necessary in Cosmographie, with the proportion of their degrees, to the degrees of the Equinoctiall.
  - 21 The distinction of Climates and the numbere of them, and howe large in breadth eche of them is.
  - 22 Of the Longitude and Latitude of regions and other places, and how bothe these ought to be taken.
  - 23 The description of the Mylke waye in the skye, whiche is commonly called Watlynge streete, and what is the cause of that coulour in it.
  - 24 The numbere and names of the chiefe signes and figures that be in the skye, and whye they be so called.
  - 25 Of the circles and mouinges of the Planetes, and namely of the eclipses of the Sonne and the Moone.

These be the titles of such matters as I haue noted in them mozte meete for this tyme, syth manye other thynges are sufficiently taughte in the former treatises, and some other thynges, namely in Orontius booke, appertaine to Cosmographie, whiche I perceauē by your sayinges, you mynde to reserue for a peculiar treatise of that matter, and therefore I haue omitted them here.

Master. So myghte you haue doone some other thynges also, whiche you haue noted here: howe be it I will vse my libertye therin, to expresse in conuenient largenes those thinges, that be meet for this place, and the rest will I touch with as conueniente briefnes: referringe the other to theyr more conueniente places.

Schollar. Syr I know right well, that your iudgement is as well to be folowed in the ordre of teaching, and choise of matter, as it is to be esteemed in the teaching and explication of all doubtfull cases.

Master. In ordre of teaching is more credit to be gyuen to a master, then in affirming of anye doctrine: for the ordre is by

is by longe experience best knowen of such men: but for affirming of any doubtfull doctrine, no man ought to saye any more then he can shewe good reason, for thapprouyng of the same. And now to your matter, although you folow the ordre of Ioannes de Sacro bosco in many of your propositions, yet will I beginne with your thirde proposition, and referre the twoo firste to a more meete place, sythe the proofof them can not well bee vnderstande, withoute a great numbre of other cōclusions, which must fyrst be proued. And for to begin with the declaration of the roundnes of the skye, and his circular motion, I thynke it good to folowe that ordre whiche mouyd men fyrste to obserue this kinde of arte.

At the fyrste beginninge of the worlde, when this arte was vnknown, menne marked the rysinge of the Sonne and the Moone, and other notable starres, as the Broode henne, whiche is called of many men the Seuen starres, and other like: and perceauinge them to rise alwaies aboute the east, and so to ascende by lyttle and lyttle to the Southe, from whence they dydde descende againe softly to the west, where they dydde continuallye sette: and the nexte daye again they perceaued them to begin their accustomed course and so continued like as before: wherein although they sawe some diuersitye, yet they perceaued that diuersitye to bee vniforme, and after a yeare to retourne to the olde state agayne. by this occasion they beganne to ymagine that thys manner of mouynge coulde not bee but in a rounde and circularre forme, and also in a rounde and circularre bodye.

*The firste  
occasion to  
thinke the  
worlde to  
be rounde.*

Then to vnderstande this matter the more exactlye, they obserued the mouinges of suche starres as neuer go vnder ground, which be about the north pole: & ther thei perceaued by diligēt marking of the, especially in the long winter nights, & that at sundry times, thei turned round about one poine in the skye: and those starres that were nigh to that poine

*The second  
occasion.*

I.ij.

did

The thirde  
occasion.

dyd make but a lyttle compas in their mouinge, and the farther that any starres were from that pointe, the greater was the circle of their reuolution. Then thirdely they marked certaine notable starres, whiche did rise and set, but yet were not farre from those other starres, whiche do neuer rise nor sett, and they might wel perceauē that they did continue but a lyttle while vnder the Horizont out of sight, wher as contrarye wayes, those starres that were farther from that point or Pole, did remaine longer time vnder the Horizont, out of their sighte, whereby they were inforced to thinke, that these varieties and formes of mouynge coulde bee in none other manner of body then in a rounde forme, and that the same mouynge was circulare and rounde, as it did manifestlye appeare in the northe parte of the skye, where the starres continually moue rounde aboute one pointe, and do neuer set vnder the Horizont. And that point about whiche they noted this motion to bee, they called (as reason inforced them) the Pole of the worlde.

A Pole.

Schollar. What doth that word signifie?

Master. It hath his name of turning: as you wolde saye, a Turne point. and it doth betoken the ende and extreame pointe of any Axetree, howe be it by speciall prerogatiue the name is appropriated to the endes of the Axetre of the worlde.

Schollar. This picture dooth some what represent the motiō of the starres aboute the north Pole.

Master. You say truth. howe be it aptly it can not be perceaued in flat forme but in a round body, as a globe is: but in that point (me thinketh) ther is no better instrument then the sky it selfe, wher euerye man maye learne that lysteth to marke, and there bee certaine notable starres in that place and namelye Charles wayne, whiche is called also the greate Beare, whose motion



is so

is so euidente, that euery childe may marke it: And twise in the yeare, that is in the middle of February and in the middle of August, they serue for a iuste horologe: so that the finger in a clocke doth not more aptely pointe the howers, then doth that figure of Charles waine.

Schollar. There can bee no more apte declaration of the roundnes of the heauen, and of his circular motiō, then the sight of those stars which moue so roundly, and kepe their quarters in heauen so precisely. and yet I haue hearde of certaine great clerks, that in no case thoughte it reasonable to affirme suche a forme of roundnes, or suche a round motion in heauen: but moſte of all I meruaile of that famous man Lactantius Firmianus, which doth affirme (as I haue hearde) that the heauen is not rounde, but flat and playne.

Master. Many scrupulous diuines by myſſe vnderſtandynge of scripture, haue abhorred the ſtudy of Aſtronomye, and alſo of philoſophye. and often tymes doo more ſharply then diſcretely raile at theſe bothe, and yet vnderſtande they not any thinge in eyther of them bothe. ſuche men are to haſtye to bee good iudges, that will ſo quickly pronounce ſentence, before they haue anye good euidence, and will determine the caſe, before they vnderſtand the matter. for how can anye man vnderſtand well or iudge rightly þ thing that he knoweth not? yet ſuch drowſy dreamers haue oftentymes deceaued many wiſe men, with their appearante reaſons, but yet none but ſuch, as either were giuen to hate the name of philoſophy, or els at leaſt had no time, or none habilitie to gette vnderſtandinge in it. By ſome ſuche men I may think that Lactantius was ſeduced: and the more eaſily, for that he had conceaued a deadly hatred againſt all philoſophers and againſt philoſophy it ſelfe: but I wil let him and his folowers paſſe, and retourne to the matter.

Schollar. Yet if it pleaſe you, I wolde gladly hear his reaſons, that he maketh for approving his opinion, ſeyng hee is named ſo greate an oratour and ſo famous in learnynge,

I.iiij.

that

Charles  
waine.

Lactantius  
Firmianus  
his erreure.

Lactantius  
opinion of  
the forme  
of heauen.  
lib. 24. c. 3

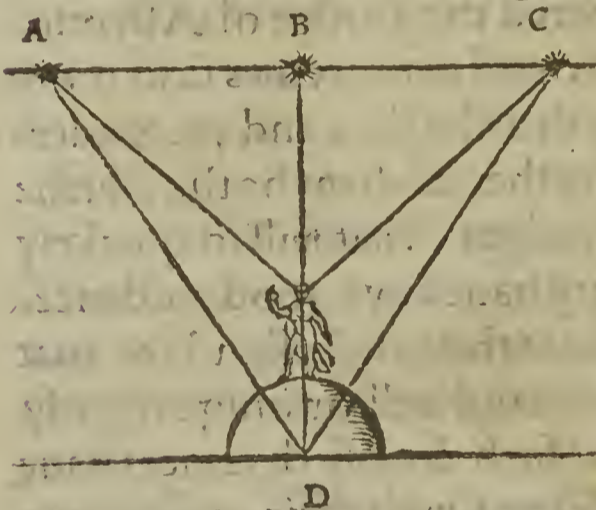
that many men will beleue him without any reason.

Master. Who so euer wyll beleue him in this point, must do it without reason: for he alleageth no reason for his purpose, but taketh it as a certaine truthe, thereby to improue the opinion of the Antipodes, as I will more largely declare anone in proouing the roundnes of the earthe. But seynge he coulde bring no reason for his opinion, you shall heare some reason against his phantasie, and then iudge as you can.

*That the  
skye is not  
flatte.*

Firste I reason thus: If the heauen be flatte and plaine as a borde, then howe so euer it stande, one parte of it muste needes be nearer to the earth then any other parte of it. and that parte by all lykelyhod must be right ouer our heddes, is not that so?

Schollar. I can not imagin els any forme of situation: and



that doth appeare partly in this figure, where A.B.C. standeth for the skye, and lyeth flatte ouer the earthe, whiche is heere represented by D: and now I see that B, whiche is righte ouer D, is muche nearer to it then A. or C, or anye other poynt in that flatte plaine forme,

whiche is sette to represent the flatte skye.

Master. Nowe then what will Lactantius say, or any man for him: doth this heauen moue or not?

Schollar. He can not deny that which we maye see with our eies, that bothe the Sonne, the Moone, and all Starres doo moue every hour continuallye.

Master. Yet peraduenture he might saye, as some other like contemners of philosophy haue saide, that the starres and Planetes do moue in the skye, as fishes do swimme in the water: and that they go forwarde thoughe the heauen

stand

stande styll.

Schollar. I remembre I haue hearde of that sayinge, and that a famous writer of late doth maintaine that opinion.

Master. What will they saye then, dooth keepe the starres in suche a iuste ordre and equalitye of distaunce: whiche neuer altered any one whitte syth the beginning of the worlde, is it possible that the starres shuld moue in the skye as fishes doo swimme in the water, or as birdes flye in the ayer, as some terme it, but that the starres muste stragle in their course, as the fyshes do, and as the byrdes also do.

Schollar. I haue seene both fyshes in the water, and foules in the ayer, to keepe a meruailous certene course in their flying and swimming, and namely fishes that go in sculles, as herringes commonlye doo, and other fyshes diuers times, and wilde geese also and storkes in their flyinge, whereof I haue often mused.

Master. You maye often see suche notable sightes: yet if you marke them, you shall see muche alteration in their flyinge, as well as in the swimming of the fishes: whereby you may think their ordre not to be constant, but somtimes one flyeth a lyttle faster, and an other a lyttle slacker: and sometime they swarue on the one side, and sometime on the other. but were it not a fonde ymagination, to thinke that starres doo flye and folowe one guide as byrdes doo, and in 5000. yeare space to keepe their places so precisely, that they varye not one minute of a degree?

Schollar. In deed it were meruailous, and so are all Gods woorkes.

Master. Yet is there one inuincible reason againste that opinion, gathered of the figure of the Milkye way in heauen; whiche many men in England do call Watlyng streete, comparing it to one of the greate highe waies in Englande that is called Watlyng streete. This Mylkie way, if it serued for none other purpose, yet doth it seeme woorthy the noting, for the exact confutation of the saide opinion, and for that

*The Mylky  
way called  
of the gre-  
kes Galaxia*

that cause it myghte seeme to bee made by God, which hath wroughte manye meanes to leade men vnto truthe. This way is in the skye it selfe, as all men hath confessed, and their eyes doo testifie, and the starres that bee in it are alwayes seene to keepe their places in it: so that it muste needes folowe, that the same waye doothe moue with the starres, and then consequentye the skye muste needes moue also.

Schollar. Yet it may be said, that the starres which bee in it doo moue alwaies so certainly in it, that it maye seeme to moue, as though it stande still.

Master. Did you euer marke the same Mylke way?

Schollar. Yea verily, and that often.

Master. And did you perceauie in it any boughts, corners, partitions, or suche other like markes, wherby you myghte knowe one part of it from an other?

Schollar. That haue I done also, in so muche that in som places it seemeth to be diuided into two waies.

Mastr. That is true. And think you if the starres did moue in it, and it stande still, that these starres which now be by the partition of those branches, muste not within foure or fife howers be passed farre from that place?

Schollar. It shuld so folowe, yet that is not so: for I haue marked the contrary ostentymes, that they keepe those places styll.

Master. Then do not the starres moue from their places, but as those places moue with them.

Schollar. It appeareth now to plaine to bee made doubtfull any more.

Master. Yet will I prooue it better. Dydde you euer marke anye notable place of that Mylke waye at the begynnyng of the nyghte in the easte, or in any other coaste of hauen?

Schollar. Yea for southe.

Master. And haue you marked whether that place hath gone anye farther westward that nyghte?

Schollar

Schollar. I haue marked it well, and haue perceaued that it hath moued a greate waye from his firste place: and who so euer lysteth to trye it, let him at sixe of the clocke in the deepe winter marke any notable places in it, and at tenne of the clocke the same nyght, hee shall perceauie it to haue gon westward more then a quarter of the skye.

Master. Your woordes are true, meanyng a quarter of the skye aboue your Horizonte: and by this you see, it can not bee auoyded, but that the skye dooth mooue as well as the starres.

Schollar. It is moste manifestly proued, so that Lactantius himselfe can not denye it, onlesse he will deny that hys owne senses may iudge in sensible thinges.

Master. Then if the heauen be flat, as he doth imagine it to be, and it doth moue westwarde, as all men dooth see, other he muste say that the skie is infinite in length, and that wee neuer see any parte of it againe after it is ones past our sighte: and therby affirme, that there be infinit many sonnes and as many moones, and an infinite numbere also of all other Planetes, and of all seuerall kinde of starres, or els hee must declare whiche waye that the Sonne, the Moone, and the other starres doo com into the easte againe.

Schollar. He can not saye that they come backwarde the same waye that they went forwarde, for then wee shoulde see them in their retourninge: and to saye truthe, there can bee none other forme of mouinge, but in rounde forme, that may bringe them into the easte againe: But peraduenture he may say, that though the skie be flat and plain in forme, yet it hath a rounde motion.

Master. Some other man may say so: for he thinketh the contrarie as his woordes importe, for in reproving Astronomers, hee saith: *Ex motu syderum opinati sunt coelum uolui.* By the mouing of the Starres they imagined that the heauen doth turne rounde. by which wordes hee seemeth to meane that the starres moue, but not the skie

Schollar

Schollar. That is fully improued before.

Master. If it were not, I myghte reason with him thus: Seyng he affirmeth as reason inforceth him, that the starres do moue, and will not confesse that the skye turneth round, then (as I declared before) one parte of the skye whiche is ouer oure headdes, is nearer to the earthe then the bothe endes be.

Schollar. That appeareth plaine, excepte hee wolde saye against all reason, that the earthe were as large as the skye.

*an argumēt  
against the  
flatnesse of  
the skye.  
The maior  
or maxime.*

Master. Yet thoughe hee woulde saye so, my reason shall proccede in full strengthe, syth some partes of the skye by his meaninge muste needes bee farther from vs then some other. Therfore I frame my reason thus: All thinges that men can see, seeme greattest when they bee nyghest vnto menne, and the farther they bee from their sight, the lesser they shewe.

Schollar. I thynke no man so childishe to denye that. for euery hower our sighte doth approue that it is so: if we see a man a farre of, he seemeth no bygger then a lyttle child: and a greate shippe farre in the sea, dooth shewe no bigger then a crow sometimes.

*The minor.*

Master. Then takinge that for a maxime in argumente, I annexe this minor, that the starres mouynge in that imagined flat skye, are most nighest to vs, when they bee ouer our headdes: and they are fardest from vs, when they be in the easte or in the weste: wherefore I inferre the conclusion, that the starres muste seeme greatest, when they be ouer our heddes: and they muste seeme muche lesser, when they be in the easte or weste.

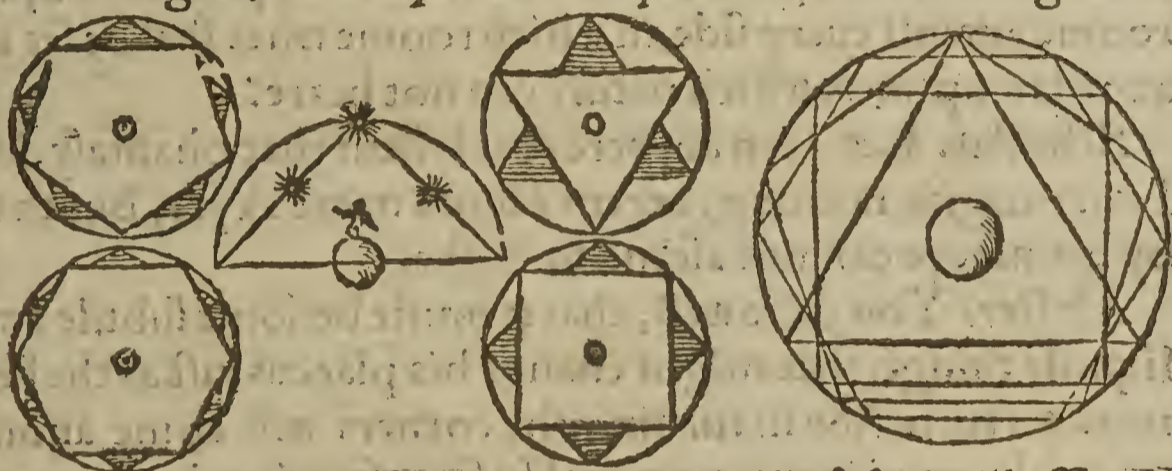
*The conclu  
sion.*

Schollar. This conclusion is plainlye false. for our eyes doo testifye the contrary, syth alwaies the sonne, the moone and the starres doo seeme greatest at the rysinge in the east, and at their settinge in the weste. And they shewe smallest, when they be nyghest ouer our headdes.

Master. If the conclusion be false, and the argument good  
as La-

as Lactantius can not comptroll it, then I maye obiectione to him his owne rule: *Necesse est falsa esse, quæ rebus falsis congruunt.* It can not be chosen but those muste be false sentences that doo agree with false matters. and so muste they needes bee false premisses, that do inferre a false conclusion.

Scholar. In good faith I thinke nother Lactantius, nother any man els is able to auoide this reason, except he will auoide that sonde opinion of imagining a flatte skye, and the standing of the same vnmouable: yet if anye man wolde saye, that the heauen were square, or of any other forme of diuers angles, as here you se many varieties in these figures.



An other reason by auoiding of emptines whiche nature cannot bere

How might I aptly reprove their opiniõ, if thei will affirme farther, that the skye with suche a forme doth moue round? for by so saying they mighte auoide the danger of this last inconuenience.

Master. While they mighte seeme to auoide one danger, they fall into an other: as for a prooffe. I tourne those figures round, wherby in deed it appeareth, that euery part of them keepe styll theyr owne distaunces vchangeably frome the centre, but yet is one parte more nerer the centre then an other parte is, and euerye parte in their turning seemeth to describe a circle about the centre, eche circle in hignes according to the distaunce of that parte whereby it is described, and so the greatest circles are made by the extreame angles, of euery figure.

Scholar. All that is easily perceaued, at the first sighte in turning the figures aboute,

K.i.

Master.

Master. Then if the heauen bee cornered, it maye haue no lesse roome to moue in, then the compasse of the vttermoste circle doth require.

Scholar. That appeareth certaine, for els it woulde staye by those corners, or els break the corners in the touning, wherof nether is to be fantasied but of fools, whose thoughts are pardonable in all those that refuse not their cōmon fellowshippe, but not in other, although for their woorthines they might be Wardens of that company.

Master. Then if for their motion they require so large a circle, as may compas their cōners, there appeareth voyde roome against euery side, in which roome what shal be set to auoide emptines, which nature can not beare?

Schollar. Let them answere that lyketh that phantasy, for I can imagine nothing, except I shuld name Ayre, but that by his nature can not ascend so highe.

Master. You gesse well, that it muste be some subtile and liquide thinge, that might change his place as fast as the heuens do turne: for in turning, the corners will come anone where the emptines is now, and so successiuelly eche chaunge place with other. but Ayer you say cā not come thither, sith it may not ascend so highe: the lyke may you saye of fier and water, and mucche more of the earth. Againe if they could ascend, how shuld they pearse through the substance of the heuens: beside that being elementes, and therefore corruptible and subiecte to daily alterations, they are vnmeet to be matched with the vchangeable substance of the heauen.

Scholar. This is reason inough against that imaginatiō, sith nature can not suffre it to bee emptye, and nothinge els but part of the skye can supplye it.

The thirde  
reason for  
apt mouing

Master. Yet considre farther: syth the motion of heauen of all other muste bee iudged the moste swiftest, whiche in 24. howers dooth runne so large a race, that is manye folde greater then the compasse of all the earthe, so that euery howe it runneth many thousand miles, dooth not this swyfte

mo-

motion require that forme, which is of all other most apte for mouing: & doth it not repugne to such formes as be full of corners, & therefore vnapt to moue swiftly or vniformly?

Sc. It appeareth plain madnes to dream ones the contrary.

Mastr. Then all men know that as cornered bodies be most vnapt for to run, so is a round globe most apt for all other.

Sc. Euery cōmon turner can skil in þe reason, & know þe a litle altering of the one side, maketh the bōul to run biasse waies.

Master. If the reason be so plaine that common artificers can skyll of it, it were to great a folly for learned menne to doubt of it.

Scholar. They that doubt of it, neuer waied their opinion with any reason, as I maye thinke, for these reasons suffice to persuade any man.

Master. Yet ones againe say this for the forme of heauen: sith it incloseth all thinges, and is the greatest of all other, were it not meete that it shuld haue the greatest forme which is most large and apte to compas and inclose all other?

*The fourth  
reason for  
capacitie.*

Schollar. It is bothe meete and necessary also.

Master. Then is it well knowne of yonge schollars in geometry, that as of all flatte formes of like circumference, the circle is the greatest, so of all sounde formes of lyke circuite the Globe is moste largest, and therefore moste aptest for the forme of the skye, whiche incloseth all thynges that man canne see.

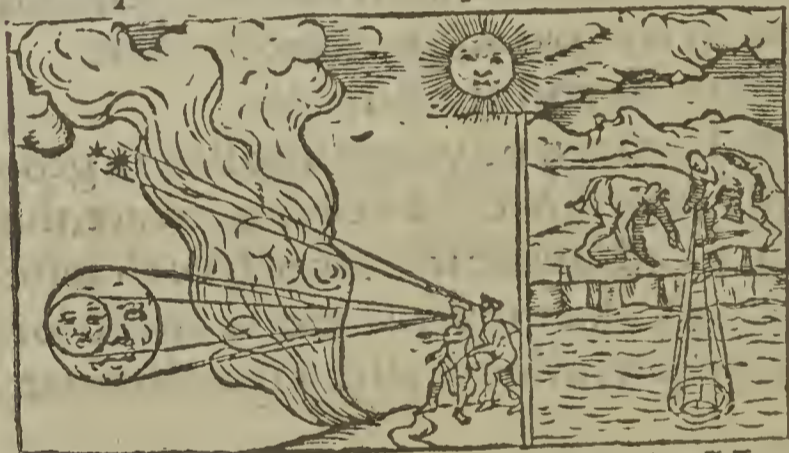
Sch. I myght be ashamed to demaunde anye more profe for the roundnes of heauen or his circulare motion, yet are the reasons so pleasante, that I delite muche in the hearinge of them, and therefore canne bee contente to imploye as muche time in hearing them, as you thinke good to bestow in framynge them.

Master. I coulde occupye you so a greate tyme: but I thinke it not best to staye thereon to longe, sith wee haue many other matters to prooue, and at other tymes we maye talke hereof againe. These reasons whiche you haue hearde

do proue not only that the motion of heauen is round, but also that the rounde forme doth best agree to the skye, for largenes of capacitye, for aptenes in mouing, for auoyding of emptines, and for the iuste appearance of the starres in vniforme bignes, whiche I thinke sufficiente for this time.

Schollar. There be twoo thinges by the waye which I desire muche to heare more largely declared: the one is for the appearance of starres, whiche seeme moste greatest at theyr risinge and settinge: the other is, for the auoydinge of emptines, whiche as I haue often hearde, so woulde I gladly ones vnderstande.

All thinges  
shew great  
through va-  
poures or  
myste.

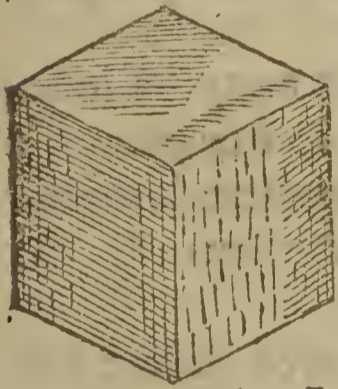


Master. The firste of them appertaineth to perspective, and the seconde vnto naturall phylosophye, so that bothe doo requyre an other place and tyme: yet bicause I haue alleaged it for this present matter, although the reasons why it is so, may not well here be repeted, yet that it is so, shall be brefely declared. In a mystie morning as you walk, all things that you see, seeme greater through the myste, then in deede they be. a pennye in the water seemeth broader then it is, and the deeper that it lyeth, the greater it appeareth: so the Sonne and the Mone and all other stars being nigh to the earth, do shew through the vapours that ascend frō the ground, and therefore appear greater then they be: & if the vapours be many, the starres shew the bigger: the cause is, the interruptiō and reflectiō of the sight beames by the vapours & the water. & like is the cause in seing through glasse, which occasioned weke sights to seke aid of spectacles.

Nature ab-  
horreth em-  
ptines.

Sch. Many vse that aide, that know not the reason thereof. Master. So manye drawe water at a plompe, that knowe not the cause, why the water dothe ascend, whiche is onelye na-

natures worke to auoide emptines. And many men vse bel-  
lowes to blow the fier, whiche know not the reason of their  
firſte inuention, and therefore can not mende them if they be  
hard to draw. many men alſo draw waters by fountaines hi-  
gher then the ſpringe, yet few of them do knowe what is the  
reason of their woorke, and therefore fewe canne amende it,  
if the faulte be any thinge doubtfull. A greate numbred of  
other lyke thinges coulde I ſhewe, where natures abhorful-  
nes to permitte any emptines, doth cauſe ſtraunge effectes;  
in thinges that are vſed of many men, and well knowne of  
fewe men. But as it appertaineth not to this place to diſ-  
coure largely in thoſe matters, ſo an other tyme ſhall ſerue  
for them. And nowe lette vs proceede in oure purpoſed at-  
tempte, to ſee what proofes I can bringe for the roundenes  
of the earth: wherein I will beginne with a diſtribution diſ-  
iunctiue, containyng many opinions touching the forme  
of the earth: and eche of them will I ſubſtantiaily improue,  
ſaue that onely whiche affirmeth it to be rounde, and that  
will I ſo fullye approoue, that I doubt not but you ſhall  
thynke your ſelfe fullye ſatiſfied. Som menne conſideringe  
that as for the ſkie no forme was ſo meete as a round forme;  
by cauſe of his ſwiſte mouinge, ſo for the carthe whiche  
ſtandeth ſo ſteddilye, they iudged no forme ſo meete as  
a Cube forme, which they eſteemed moſte  
ſtable of all other: and therefore manye  
aunciente Philoſophers by the forme of  
a Cube dydde ſecretely ſignifie conſtancy  
and ſtablenes: and contrarye waies by the  
forme of a globe they expreſſed changable  
alteration, and continuall mouing.



*Diuers opi-  
nions of the  
forme of  
the earthe.*

*Why fortun  
is pictured  
ſtanding on  
a globe.*

Scholar. That I may perceau by the placing of Fortune on  
a rouling globe, in token of hir inſtancy & voluble chan-  
ginge. And therefore haue I often phantaſied, that dice,  
whiche is the image of Fortunes inſtancye, and ſerueth  
onlye for fortunes playes, myghte beſte haue bene made

*Why dice  
be made in  
cubik form.*

in forme of a Globe, for they are as vnconstant as fortune hir selfe.

Diuers for-  
tune.

Master. Ther seemeth in Fortune two diuers natures, the one is lyghte and alwaye flickerynge, the other is heauy, and therefore more stable, so that ofte tymes we see them that haue a lyghte and pleasaunte fortune, as lightly leese, that they lightly gayned: but where heauye fortune setteth hir foote, Ieldom can she be remoued, hir steppes are so stayed: but to expres more exactly the nature of the cube resembled in the dice, bothe in forme and in effecte, you shall marke well the meaning of that olde prouerbe: *lacta est alea*, The dice is caste, or the lotte is drawen, or fortune is past, by whiche saying is declared, that the thinge that is ones done, can neuer againe be vndone, although it may be altered, and so cōstancy in that appeareth most certein. for as your chance on the dice beyng ones caste, you muste be content to stand to it: so fortune when it is paste, can not bee altered. And that is the cause why all men vse to saye, when they expresse their stay in lyuing: Suche is my fortune. Yet many learned men put difference betwene chaungable chaunce, and stable fortune, callyng the firste *Fortuna*, and the other *Fatum*: so that destiny is stable, though fortune chaung right often. But thus I forget our purposed intent, with so many digressions of other bye matters.

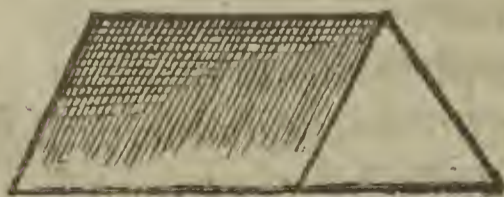
Schollar. I founde no faulte nor thought no tyme losse, syth the matter is pleasaunte and somewhat to our purpose.

Master. Well, this was their imagination, that thoughte the earthe to be of a cubyke forme, for that they iudged it the most stedfast form.

The second  
opinion.

Then an other sorte deuised a three cornered forme like

A rygge forme.



the rygge of an house where one syde lyeth flatte, and the other two leane a slope. And thys forme they iudged better for two causes. Firste they thought that it

was

was more steddily then a cube form, because it hath a broader foote, and a lesser toppe: and secondly for that they thought it a more apte forme to walke on, and more agreable to the nature of the earth, wher some times there ryseth highe hils, and sometime againe men may see greate vales descendyng.

Schollar. This imagination is grosse inoughe.

Master. And so grosse is the iudgement of them that followe not, or searche not for true reason, but content them selues with a lyght conceaued fantasie.

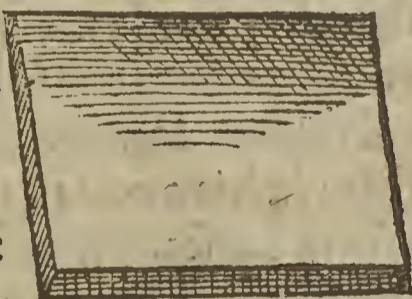
Schollar. And in this they be deceaued, that they accompt this form more apt to walke on: for the flat of the cube is plainer, & therefore more apte to walke on, then is a slope ground.

Master. If the syxte parte of the earthe were onely inhabited, then woulde it appeare so in deede: but if you go any farther, then haue you vnapt plaineesse to walke on in theyr imagination, whiche go so downe righte, that they do feare fallynge. Againe they thinke this Rigge forme meetest for the standing of the sea, and for running of riuers: for in the fyrste forme, if the sea should reste on the ouermost plaine, then wolde it ouer runne all that plaine, and so flowe ouer all the earthe: where as in this seconde forme it mighte reste about the foote of the earthe, and yet the slope risynge wyll not permit it to ouer runne all the earthe. And so for riuers if there be no slopenes (as in a cube there is none) then can not the ryuers runne well.

A thyrde secte thinkinge to amende these bothe, imagined the earthe to be plaine and flatte: for so they fantasied that it wold rest mooste steddilye, and so was it very easy to walke on.

A playne Flatte.

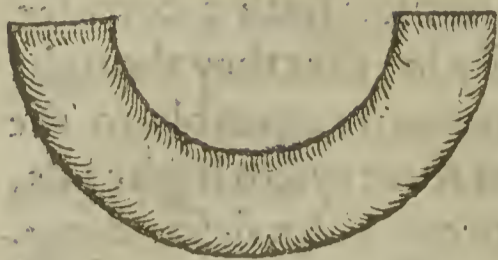
The thyrde opinion.



Schollar. We are more beholdynge to those men, for deuising our easy walking, then we are bounde to them for their wise doctrine.

Master. The fourthe secte, fearyng least by this opinion they shoulde leese the sea and all other waters, imagined the

The fourthe opinion.



forme of the earthe more apte to holde water, and deuised it hollow lyke a bolle.

Schollar. Those men were verye studious for staying of water, more then they were for fram yng of their wittes.

Master. Yet this vaine follye didde seeme to them grea te wisedome.

Schollar. Saue that I do credite your report, I wolde neuer haue thoughte, and muche lesse haue beleued, that euer anye suche madde imaginations hadde beene phantefied of anye men.

Master. Who lysteth to see the monstrouse opinions of suche dreaminge doters, maye reade them often touched in Aristotle his naturall bookes, and abundantly in Plutarche his boke De philosophorum placitis. and in Galene and Eusebius in bokes of the same matter peculiarly writen. But these 4 opinions which I haue here reherfed, are briefly noted in the firste boke of Cleomedes sphere, though not in like ordre: and saue that in the seconde opinion I iudge his printe corrupt, and that for  $\pi\upsilon\gamma\alpha\mu\epsilon\iota\delta\eta\varsigma$ , I do reade and translate  $\pi\epsilon\iota\sigma\mu\epsilon\iota\delta\eta\varsigma$ ; as it may well be gathered by his owne confutation, which will not agree so well for confuting al stiple formes or spire formes, but as mens iudgment ought to be free, so if any mā list to folow  $\pi$  print, I wil not withstād him.

Schollar. Although some of these opinions are so grosse that they neede no confutation, yet I praye you repeate the confutations that Cleomedes doth vse.

Master. I am well content, and better pleased to alleadge them in his owne name, then to ascribe them to my selfe, for diuers causes. Firste he beginneth with the thirde opinion, and reproceth it thus. If the earthe were flatte and plaine, then should all nations haue one horizont: for in a plaine flatte forme, there can be no iuste cause of alteration of the Horizont.

he reprofe  
of the third  
opinion.

Scholar.

Scholar. That foloweth moſte certainly.

Maſter. Then muſt the Sonne and Moone and all other ſtarres riſe to all people, when they riſe to anye one, and ſo muſte they ſette (eche one in his courſe) to all men at one inſtante.

Schollar. That will followe alſo.

Maſter. If the Sonne riſe to all men at ones, and ſette like wayes at one time, then muſte the daye beginne to all people at ones, & all nations muſt haue night at one time precisely.

Schollar. That is falſe as all men confeſſe: for at Hieruſalem (whiche is well knowne) it is day thre houres ſoner then with vs, and ſo is it nyghte ſooner by thre howers alſo. But in Calecut (as learned men affirme, and trauelers thither, do confirme) it is daye 6. howers ſoner then with vs, and it is night 6. howers ſoner to them againe then to vs.

Maſter. Your ſayinges are true if they be well taken: but and if this concluſion bee falſe, as it is in deede, then muſte that opinion be falſe, whereof this concluſion is inferred.

Schollar. So doth it well folowe, and is fully prooued.

Maſter. One ſtronge reaſon for the varietie of howers is gathered by the eclipses duly obſerued, and namely of the Moone,, for as it happeneth at one inſtance of time, ſo is it not one hower to all nations. As for example: This year of 1556, the eclipse of the Moone ſhall be with vs the 17 day of Nouembre at 3. of the clocke in the morninge, and to them at Calecut it ſhall be at 9. of the clocke in the morning: yea we ſhall ſee the Moone in the ſouthweſt, and they ſhall not ſee her at the ſame inſtant, for ſhe will be to them vnder the horizont in the northweſt. like waies in the yeare of 1562. there ſhall be a great eclipse of the Moone with vs, whiche ſhall endure aboue three houres and an halfe, and yet ſhall they at Calecut ſee no part of it, by reaſon that the Moone ſhall be farre vnder their horizont before that eclipse begin. And in lyke manner this laſte yeare 1555. was there a greate eclipse of the Moone the fiſte daye of Iune, at three of the clocke in the morning, yet in Calecut there was none eclipse

Examples  
of eclipses.

ſcene

scene then, for the Moone was set vnder their horizon two howers almost before the eclipse began. But in the yeare of 1551. when we had the eclipse of the Moone at 9. of the clock at night, the 20. day of February, they at Calecut sawe that eclipse at thre of the clocke in the morning the nexte daye, as the Portingales that were there can testifie. Wherby it is manifest, that their Horizon doth not agree with ours, and thereof doth it folowe that the earth is not flatte. But nowe to returne to Cleomedes againe, (vnto whose wordes I haue added but the examples of the eclipses) his seconde reason against the flatnesse of the earth, is this.

*An other re  
prose of the  
flatnes of  
the earthe.*

If the earth were flatte and plaine in forme, then the Pole must needes appeare at one height to all parts of the world, and the artike circle (which incloseth the starres that neuer set) shuld be but one to all nations. But bothe these thinges appeare plainly false: for as vnto vs about London the Pole is not fully 52. degrees highe, so if you go northward, you shall fynde the Pole to rise higher and higher, till it bee fully 55. degrees highe. and in going southward, the eleuation of the Pole waxeth lesser and lesser, till you come to the middle of the earthe vnder the equinoctiall, where the pole is of no height, but is equall with the Horizon. Also in all these places, you shall haue seuerall arctike circles.

Scholar. That must needes folow the diuersitye in the eleuatiō of the Pole, as it hath been sufficiently declared before

Master. As the firste improbation doth reprove the flatnes of the earth betwene east and weste, bicause it regardeth chiefly the rising and setting of the Sonne and other starres, and their course betwene east and west, so this second confutation improueth the opinion of plainesse betwene south and north. So doth it folow, that the earthe is flatte nother one way nother other, but bothe waies hath some certain rising, which anon I will proue to be a iuste roundenes.

*The thirde  
confutation*

A thirde reason is alleged by Cleomedes, touching the equalitie of daies to all nations, which shoulde of necessitye folow

follow if the carthe were flatte, and all people had one horizont, but bicause it is so little disagreeable from the fyrste reason of one Horizont, and one tyme of risinge and settinge of the sonne, I have ioyned them both in one, as before it dothe appeare. These thre reasons are plaine inough. The fourth reason whiche Cleomedes doth make, is not so easye, yet is it as certaine as any of the other: and therefore I will shewe you what it is, seying you desire to heare his owne arguments, although I determined before to allege such reasons only, as myght appeare easy to vnderstand.

Scholar. If it be not ouer muche obscure, it may please you to declare it in the moste playnest forme ye can.

Ma. I will only alter his ordre in the propositions, adding that wich is not easye to be gathered, to make it the easier to your vnderstanding. This is it.

If the earth were plaine, it shoulde folowe, that the whole diameter of the world from one side of the sky to the other, shoulde be but 100000 furlonges, that maketh 12500 miles, which saying appeareth so absurd, that no man will graunt it. but if any man wold do it, this argument folowing shall cōfute him. First therfore I reason thus. If the earth be plain, then al places in the earth ar as far a sonder, as their Zeniths, or Verticall pointes be in heauen. This maxime must I adde vnto Cleomedes, to make his reason the more plaine.

*The fourth  
confutation  
of the plain-  
nes of the  
Earthe.*

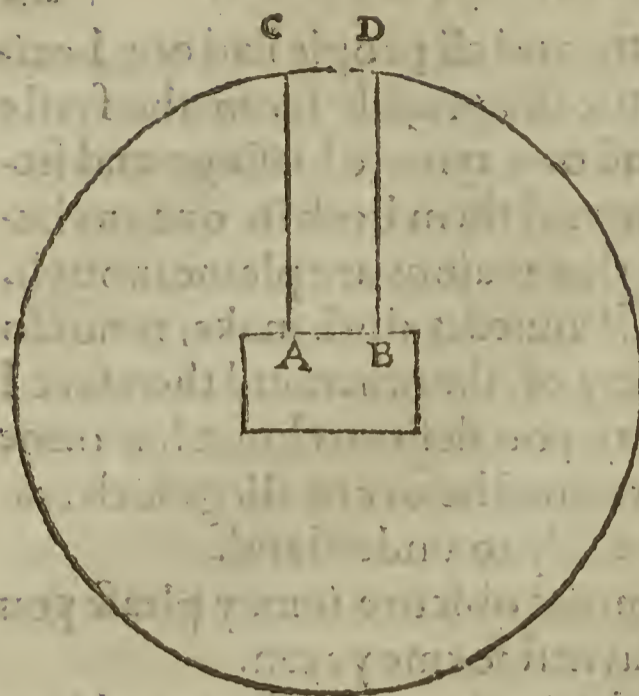
Scholar. But this maxime do I not vnderstande, wherfore I beseeke you both to proue it, and declare it.

Master. I am content.

You knowe by the former treatises, that the Zenith is the pointe right ouer the headde of any people, whose Zenith it is: whereof it muste folowe that euerye diuers place in earthe, muste needes haue a seuerall Zenith in the skye.

Scholar. That is plaine.

Master. Then imagining the earth to be flatte, the lynes that dooth ascende from any twoo places, vnto theyr Zenithes in the skye, muste needes be paralleles, as here in this  
picture



picture doth partly appear: for if the circle be let for the skye, and the flatte square within it for the earthe, then take two places in the earth, as A and B. the zenith to A is C, & must needs be right ouer it, and therefore the line that is drawn from A to C, must be a iust plumb line, & perpendicular to the flatte earth. And likewise the zenith to B is D, which muste

needes be righte ouer it, and therefore the line that goeth frō D to B, must of necessitye be a perpendicular and plumbe line to the flatte earthe also. Then if bothe those lines be perpendicular to one flatte plaine, or to one line standinge. for that plaine flatte, all the angles that they bothe doo make with the thyrde lyne A B, muste bee righte angles, accordinge to the definition of a perpendicular line. Nowe if all their angles be right, then are they all equall accordynge to the fourthe grauntable request in the seconde booke of the Pathway, that all righte angles be equall eche to other. And if all their angles be equal, then must their matche angles be equall of force: wherby it doth folow accordinge to the 18. Theoreme of the seconde booke of the Pathway, that those two perpendicular lines be paralleles, seyng that on 2 righte lines, as A C and B D, there is drawn a thyrde ryghte line A B, crossewayes, and maketh twoo matche corners of the one lyne, equall wyth the lyke twoo matche corners of the other lyne.

Scholar. Hereby I haue not onely gotten the vnderstanding of your prooffe, but also I perceauē a farther vse in the Theoremes of the Pathway, then I knewe before.

Master. I will prosecute my prooffe. Syth those twoo  
lines

lynks bee paralleles, and equallye distaunte, then is there as much space betweene A and B, as there is betweene C and D.

Scholar. Thus is your maxime sufficiently proued, and fully declared: for A B betokeneth the distaunce of the two places in earth, and C D, standeth for the distaunce of their zeniths in the skye.

Master. Nowe therefore will I retourne to Cleomedes argument. They that dwell at Lysimachia (in Grece) & they that dwell at Syene (in the southe parte of Egypte) haue betweene them in distaunce 20000 furlonges (that is 2500 miles) wherefore it must folowe that their zenithes in the skye be no farther asunder, seying they be limited by two perpendiculars equallye distaunte: but it is well known by good prooue of instrumentes, that Syene is vnder the Tropike of Cancer directly, and Lysimachia is vnder the hedde of the North dragon, which 2 places in the skye are iustly proued to be asunder the 15 part of the whole compas of heauen, that is the first part of the diameter of the skye. Wherefore if 20000 furlonges be the first parte of the diameter, the whole diameter must be but 100000 furlonges: & the whole compas of the skie muste be but 300000 furlonges, and of these furlonges it is prooued, that the earthe containeth in compas 250000. so is the heauen lyttle bygger then the earthe in compas. whiche absurditie maye easily be confuted by the Sonne, whiche in comparison to the skye, is a verye lytle parte of it, and yet is bygger than the earthe mannye folde: whereby anye manne maye see what absurditye foloweth that opinion, to thynke that the earthe is flatte.

Scholar. I doo metely well vnderstand this reason, but I shuld better haue conceaued it, if I had knowen the two places whiche hee alleageth for examples sake.

M. Then will I for your pleasure make y<sup>e</sup> like argument by example of 2 places which ar better knowen to english men.

L.i.

You

A like reason.

you knowe the castle of Arundell.

Scholar. The name is auncient and famous.

Master. And Newe castle vppon Tine is well knowne to you also. Scholar. So is it.

Arundel ca  
fle.

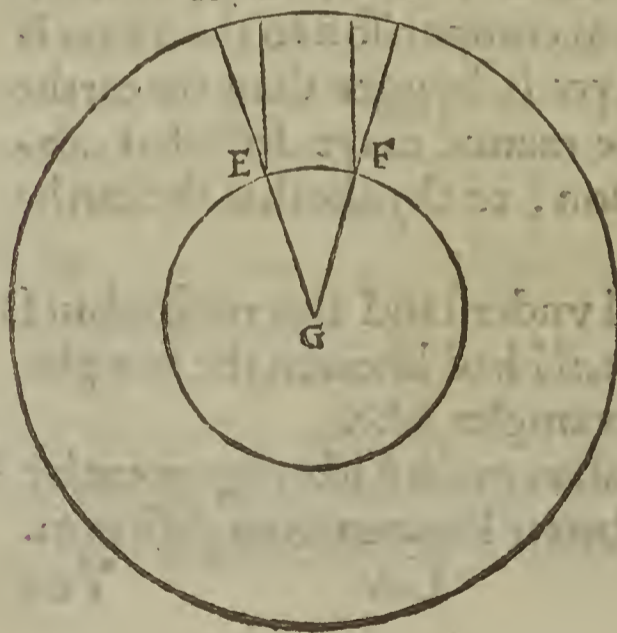
Master. To go the next waye betwene these two places it is 270 englysh myles. And the Zenith of Arundell castle (whiche is the iuste point of the latitude of it) is 50 degrees and 30 minutes, as ones I remembre I tooke note of it in riding that waies. The Zenith also of Newcastle is from the equinoctiall 55. degrees, so is the difference betwene their zeniths 4 degrees and 30 minutes. Now (as I haue declared before) If the earthe be flatte and the perpendicular re lines bee paralleles and equidistant, that go vp from these two places to their zeniths, then is 4 degrees and 30 minutes, iust equal in quantity to 270 myles.

Sc. That is true, as it is proued before in the third treatise.

Master. You are farre deceaued: it is declared there, that 270 myles in earthe, muste answere in proportion to foure degrees and an halfe, and not that they are equall togyther.

Scholar. I perceauie mine owne negligence in markinge the propretye of speache. I shoulde haue sayd, that as foure degrees and an halfe is the eight score part of the whole compas of heauen, so 270 myles is the eighte score parte of the

A B C D



Master. That is true: but yet these 2 partes are as farre vnequal in quantity as heauen & earth are vnlike in their compas, wherfore to the intent that frō henceforth you shall not mistake it againe, I wil by lineary demonstratiō set before your eyes the declaration and difference of them

them bothe more plainly then curiously.

Here in this figure you see two circles drawen vppon one centre, their common centre being G, from which there are drawen to the vttermost circle two right lines G A, & G D, these lines do crosse the lesser circle in 2 pointes B and F, from whiche two pointes I haue drawen twoo paralleles, vnto the circumference of the greater circle, whiche two paralleles be B E, and C F. Nowe may I say, that bicause these two circles be made vpon one common centre, and twoo lynes drawen from that centre to the circumference of the both circles, bicause A G D is one common angle in them bothe, therefore are there arche lynes inclosed betweene those two ryght lynes lyke in proportion.

Scholar. I perceauē it well: so that if the arche lyne A D in the greater circle, be the syxte parte of it, then is E F the arche lyne of the lesser circle, the syxte parte of his owne circle, in lyke manner. but yet that arche of the lesser circle is not so greate as the lyke arche in the bygger circle.

Master. Then what saye you of the arche B C, in comparison to the arche E F, whiche bothe arches are betweene twoo lines paralleles?

Schollar. They muste needes bee equall, seynge there is iuste as muche distaunce betweene E F, as there is betweene B C.

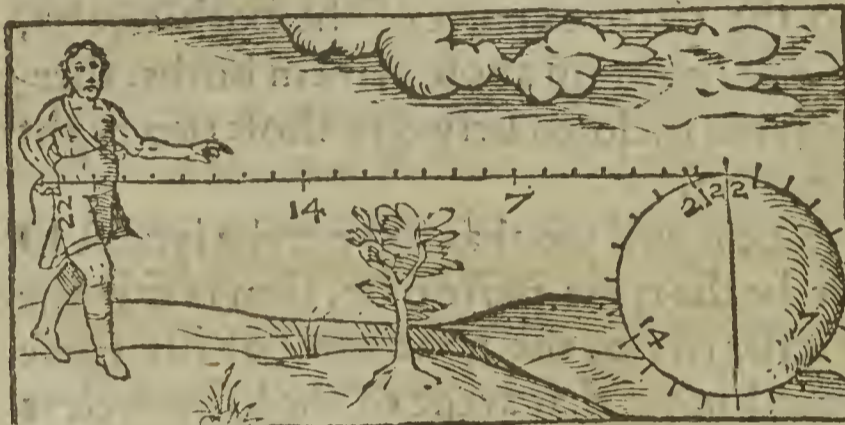
Master. So maye you nowe perceauē what difference it is to saye, that two arches of two seuerall circles, are like in proportion: and to saye that they are equall in quantity.

Schollar. Nowe I perceauē it plainly, that although 4 degrees and an half (as your former reason did import) be like in proportion to the whole circumference of heauen, as 270 miles are in comparison to the compasse of the earthe; yet it soloweth not that they should be equall togither.

Master. But supposynge the earthe to bee flatte, then it soloweth as I haue declared beefore, that they are equalle in quantite, seynge bothe beetoken the  
L.ij. distance

distant of one couple of paralleles. And the it foloweth, that seinge 4 degrees & a half is the four score part of the compas of heauen, if I multiply 270 myles. ( whiche is equall to it) by 80, therof will amounte the numbres of myles that make the compasse of heauen, whiche are 21600 myles. Nowe to know the diameter of it, I take the two receaued numbres for the proportion betweene the circumference of a circle and the diameter of it, whiche are 22 and 7, (as in the Pathway is declared more largely ) and by the rule of proportiō I work

270  
80  
21600



in saying: if 22 giue 7, what shal 21600 yelde? and there amounteth 6872<sup>8</sup>/<sub>7</sub>, whiche must be the whole diameter of the skie, if the earth were flatte.

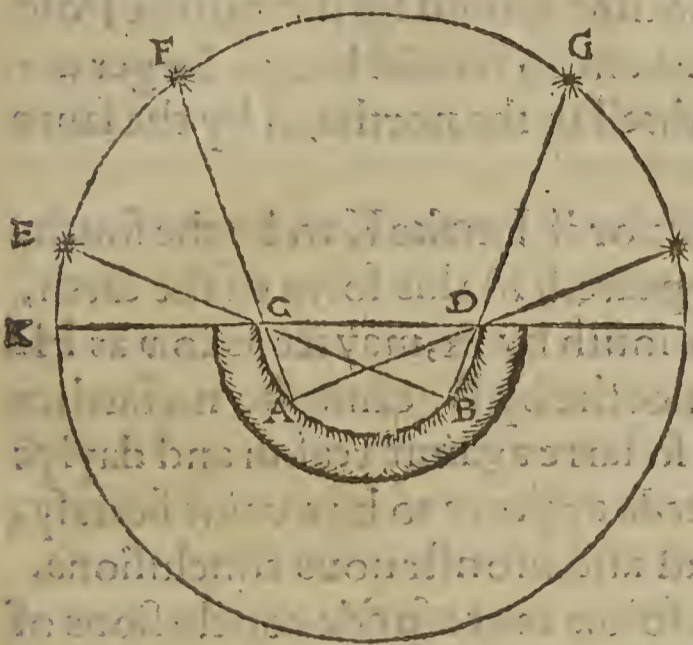
Scholar. That is to greate an inconuenience for any man to affirm, for therby I se it wold folow that if we go any waye from our owne cuntry, 3436 miles, we shal com hard to the sky, which is to childishe a fantasie, sith not only reason, but dayly trauell declareth the contrarye. Againe I remembre that in the thirde treatise you declared that the earthe was so muche in compasse, whiche muste needes bee many fold lesse then the heauens, whiche ar so farre distaunt from the earthe on euery side.

22 7  
21600 6872<sup>8</sup>/<sub>7</sub>  
x  
x 3 x x  
3 9 6 6 6  
x x x x x (6872  
x x x x x  
x x x

Master. Thus are all Cleomedes reasons against the flatnes of the earth fully alleaged, & somewhat largely declared: Now wil I proceede to the confutatiōs which he vseth against the other opiniōs, folowig his own ordre. wherfore next doth folowe

folow the confutation of them which say that the earth is hollowe like a bolle. Against whose phantasticall imagination he reasoneth thus: If the earthe were hollowe as a bolle, then should the Sonne, the Moone and all Starres in their rising appeare soner to them that dwell in the weste, then to them that dwell in the easte: whiche thinge is contrary to daily ex-

*The confutation of the fourth opinion.*



perience. For declaratiō of which saying by lineari demōstration I think good to drawe a figure, wherein you may aptly se the force of his reason.

The vttermoſt circle of þ figure doth represent the ſkye, and the innermoſt half circle ſtādeth for þ imagined hollownes of the earthe, & the

halfe roundelet A B, representeth the maſſy ſubſtance of the earth, the right line K L, expreſſeth the diameter of þ world, and therefore the right Horizont of the earthe, K beinge the eaſt and L the weſt. Now for explication of Cleomedes reaſon: If the earthe were hollow, as here the forme of it is drawen, then when the Sonne is riſen, in the eaſte aboute E, it wold appeare to them that dwell in the weſt by B, & not vnto them þ dwell in þ eaſt by A. for the browe of the hollow ground by C, doth hide the Son yet frō them, ſo þ he muſt aſcend as high as F, before they þ dwel in the eaſt by A may ſee hym. Again when þ Son goeth doune, by this opiniō he ſhuld ſet to them that dwel in the weſt by B, as ſone as he came to G, by occaſion of the browe of the ground by D. and yet they that dwell in the eaſt by A, ſhould ſee him a great while longer: for that browe of ground by D, wyll not yet hynder their ſighte, vntill he be deſcended as low as H. So ſhoulde they that dwell in the weſt ſee the Sonne ſooneſt in the mor-

L.iiij.

nynge

ning, and they that dwell in the east shoulde see him latest at eueninge.

Schollar. This thinge is so false, that euery chylde knoweth the contrarye.

*An other  
reprooffe of  
the same o-  
pinion.*

Master. Yet of that opinion dooth there folowe farther inconueniency, as Cleomedes doth shew: for by this fantasye, they that dwell in the southe should see the northe Pole more higher aboue ground, and so should haue a larger arctike circle, then they that dwell in the northe, as by the same figure it may be declared.

Scholar. I perceauē it well: for if I make K to be the south, and L the north, then it appeareth in this form of the earth, that they which dwel in the south by A, may see as low as H: and they that dwell in the northe by B, canne see no farther northe then G, whiche is so farre against reason and daylye experience, that it must needs appeare to be a vaine fantasy, that bringeth forthe so mad and monstrous conclusions.

*Yet an o-  
ther confu-  
tatio of the  
same opinio*

Master. Yet doth there folow more fonde conclusions of it: for by this opinion all nations that dwell within that holownes, should see lesse then halfe the skie, lesse then halfe the Zodiak, and lesse then halfe the Equinoctiall, wherof it wold follow (beside other absurdities) that they shuld haue their nighte commonly longer then their daye, bicause that parte of heauen which they se is lesse (especially to them that dwell in the botome of that holownes) then that part which is vnder their horizonte: Yea they that dwell in the botome of that holownes, canne neuer haue their daye so longe as their nighte, bicause they do see so litle a portion of the skye. As a man that is in a deepe trenche or in a pitte, can see but a litle of the heauens. And thus hath Cleomedes sufficientely confuted those two opinions: whiche kinde of confutation Ptolomye doth vse also against bothe those opinions.

*Ptolomye.*

Scholar. Then must they needes be good: for as I heare all learned men say, Ptolomye is the father of that arte, and proueth all his woordes by stronge and inuincible reasons.

Master.

Master. No man can worthely praise Ptolemye, his tra-  
uell being so great, his diligence so exacte in obseruations,  
and conference with all nations, and all ages, and his rea-  
sonable examination of all opinions, with demonstrable con-  
firmation of his owne assertion; yet muste you and all men  
take heed, that both in him and in al mennes workes, you be  
not abused by their autoritye, but euermore attend to their  
reasons, and examine them well, euer regarding more what  
is saide, and how it is proued, then who saith it: for autori-  
tie often times deceaueth many menne, as here by and by in  
Cleomedes it shall appeare, whose argumentes in confuting  
the other two opinions ar nothing substantiall: which chanced  
other bicause he sawe the fondenes of these opinions so  
great, that he sought no great reasons to confute them, other  
els hastinge in his writinge caused him to vse the lesse dili-  
gence in framynge his reasons. but nowe will I repeat them.

*Autority of  
writers.*

If the earth were of cubike forme, then should all nations  
haue syxe howers daye only, and 18 howers nyght, seing ther  
be rounde about the cube four sides, so that on eche of them  
the Sonne shoulde shine 6 howers only: this is a very weake  
argument.

*Cleomedes  
argumente  
against the  
first opinio.*

Schollar. Yet vnto me it seemeth a strong reason: for se-  
ing that the Son doth go round about the skie and aboute  
the earth also iust in 24 howers, it must needs folow that he  
spendeth only 6 howers in euerye quarter: and a cube hathe  
but four sydes in his compasse, (althoughe it haue 6 sides in  
all) wherfore in mine opinion it is well concluded, that euery  
one of tose four sides, doo see the Sonne 6 howers iustlye.

Master. Often haue I readde in Galene, and more often  
haue I seen it by experience, that better it is for men to want  
all arte of reasoninge cleane, then to haue suche confidence  
in a meane knowledg therof, that may occasion them to de-  
ceauce them selfe, and to seduce other. You are fully perswa-  
ded that this argument is good: whereby it appeareth that  
you espied not the want of that meane proposition, whiche

L.iiij.

should

should make the argument good, which muste be this: that euery quarter of the sky, agreeth to one quarter of the earth.

Schollar. That not only I thinke to be true, but your selfe affirmed it also before this time, as a true sentence.

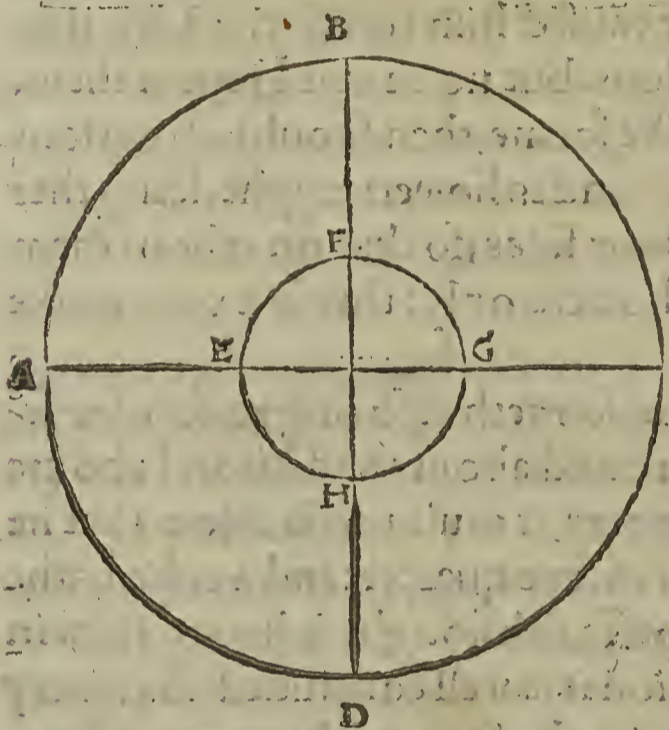
Master. And so will I do still, affirming it of the true form of the earthe, but not of this imagined cube forme.

Scholar. Why, is there anye difference in the quarters of any formes? is not a quarter of a cube the fourth part of it, as well as a quarter of a Globe is  $\frac{1}{4}$  fourth part of the globe?

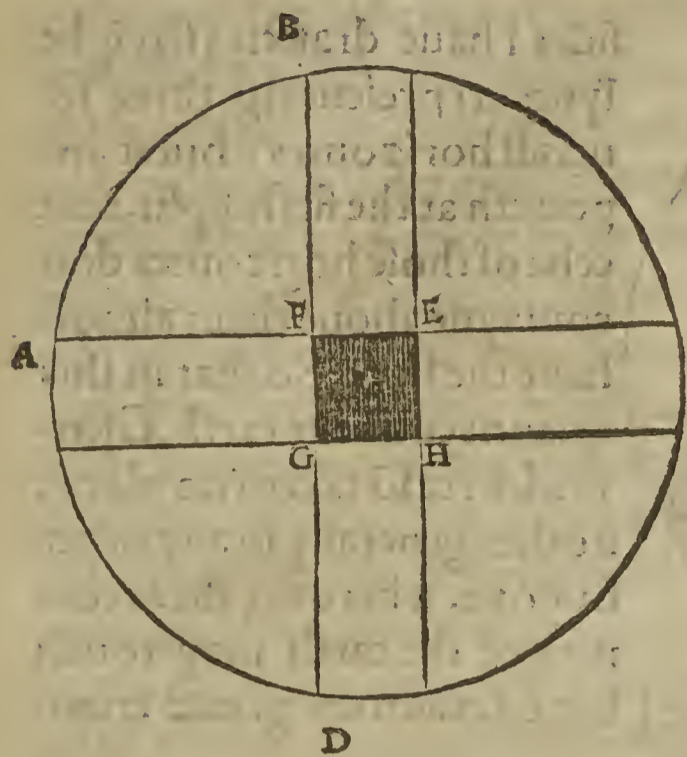
Ma. Yes, but yet doth not the quarters of the cube so agree with the quarters of a globe, as the quarters of two globes agree together.

Scholar. That I vnderstand not.

Ma. Then will I declare it manifestly by lineary demon-



stration. Marke these figures. Here you se first for the true opinion, 2. circles drawn one within the other vpon one centre, and the same are diuided into four quarters ech of them, so that the four quarters of the lesser circle, EFGH, do answere agreably to the four quarters of the greater circle ABCD, but in the secōd figure, where the cube is made in lue of the earthe, the quarters do not agree, as you may perceauē by the draught of the right lines, agreable to eche side of the cube: for euery side of the cube hath almost halfe the circle aboue his horizontall line. Wherefore if you will haue a cube drawn in a globe, in such sorte that the quarter of the one in cōpasse shall agree to the like quarter of the other, that cube muste be so great, that his corners



corners may touch the globe on eche side, so muste it bee as greate a cube as maye bee made within that globe. And I am sure you will not say that the earthe is so great in comparison to the skye.

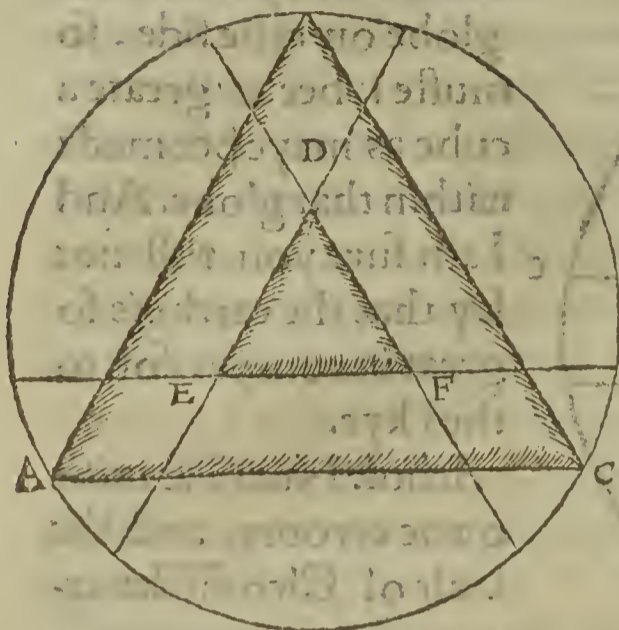
Schol. Now I se mine owne erroure, and the fault of Cleomedes argument.

Master. And if anye man wold excuse Cleomedes, he must say, that Cleomedes did make & reason against suche as affirmed two errours at ones, that is the cubike forme of the earth, & the greatnes of it also to bee suche, as mighte touche the skye with e-very corner: but if this had been his meaninge

he might easily haue expressed it so: but what so euer he ment he framed the confutation of the second opinion in the like sorte. for this is his argument.

If the earthe be of a three cornered forme, then shuld the Sonne shew s houres iustly on eche side of it, and so wold it be to al people s houres day, & 16 houres night: which thing is to appearant false: so can not that opinion be true. for declaratiō of this argument I haue drawn first a circle for the sky, and then a small triangle forme D E F, vnto whose thre sides

Cleomedes  
confutation  
of the secōd  
opinion.



sides I haue drawen 3 streight lynes, representing three seuerall horizontes. but it appeareth at the firste sight, that eche of those horizontes doo contayne aboute them almost halfe the skye. So that in this quantitie of the earth, Cleomedes reaso taketh no place, nother generally in any other but one, where the three corners of the earth may touch

the skye, for whiche forme I haue drawen the greate triangle A B C.

Scholar. Yet, although Cleomedes argumentes bee not sufficient to confute their opinion; that would say the earth were of any of these bothe formes, their opinion is false neuerthelesse. thinke you not so?

Master. Yes verely: for a weake confutation of an vntruth doth not make that vntruth to become true. And bicause you shall not thinke that these opinions haue anye sure ground, I wyll repeate Ptolemeys hys confutation of them both, by one vnfallible reason.

Ptolemy his  
confutation  
of the firste  
and seconde  
opinions.

You see in bothe these imagined formes of the earth, that there can be no more horizontes, then there be sides in the fygure.

Scholar. That is certaine: for all that dwell on one plaine side, must needes haue one horizont: wherfore if the forme of the earth wer four square in his compas, then could ther bee but fower Horizontes, that waye: I vnderstande it betweene east and weste, and in all varieties there canne be but syxe, syth a cube hath but syx sydes: lykewaies in the thre cornered forme, there canne be but three diuers horizonts betwene east and west.

Master. You saye well. And seeynge all that dwell on one

on one plaine syde haue all one horizonte, they muste haue day all at one instant both for the sonne risinge and also for the settinge, so can ther be no more variety in the beginning and ending of daies, then there are sides in the figure of the earthe, whiche by the firste opinion must be but 4, and but 3 by the seconde opinion, where as the contrary is well known by daile experience, as well as by reason, that euerye 15 degrees in distaunce westwarde maketh the daie an hour later: and contrarye waies euery 15 degrees of distaunce eastward, causeth the daie to be rather by one howers space.

Sch. That is proued also before, in confutation of the third opinion, and namelye by examples of eclipses. But what if any wolde affirme that the earth were made of many flattes, as of 24 (for an example) betwene east and west, then shuld there be no more horizontes, then there bee howers in one naturall daie, and yet so the difference of howers could not confute them.

Master. You must thinke that learned men canne as well marke the difference in euerye minute of an hower, as the common people can obserue diuersities in howers: yea the learned obseruations are more exactly taken the 60. part of a minut of an hower, wherfore seying it is so well proued by sondry obseruations, and especiallye by eclipses, bothe of the sonne and the moone, that euerye mile distaunce betwene easte and west, dooth make a seuerall horizonte, there can bee no other forme of the earthe aptlye assigned, but a rounde circular forme. And by the lyke reason, by the ordely ascending of the Pole, in goinge northward, and by the vniforme descending of it in going southwarde, it must needes appeare that there can bee none other forme of the earthe betweene southe and northe, but a rounde forme also.

Scholar. Nowe canne I ende your argumente of the distribution disunctiue, whiche maye be framed thus.

The earth must haue some forme, either cubike, thre cornered, flatte, or holow, or some suche lyke, other els a round forme

The collection of the arguments

*By distribu-  
tio disjunc-  
tiue.*

forme, but his forme can not be cubike, nor thre cornered, nother flatte, nother holow, nor anye suche lyke, as before is fully prooued, wherefore it muste needes be rounde.

*A roller  
forme.*

Master. It foloweth well. for it is not possible that in any other imagined forme of the earthe, the horizontes should alter toward euery coaste so vniformely, and the dayes differ so proportionably, the Pole to be eleuate so ratably, or to be depressed so ordrely, and all other appearances to answer so agreably. Yet some men (as Ptolemy doth reporte) had inuented an other forme lyke a roller, or a rounde pyller, whose endes shoulde lye north and south, by whiche forme althoughe they thought none of the varieties of appearances myghte bee hindered, yet in that forme the eleuation of any one of the Poles could haue but two varieties, for euer more it muste appeare other ouer their heddes, as to them that dwell on the flatte eandes of that roller, or els to all other that dwell about the compas of the roller; it must still appeare in their horizonte, so shoulde ther bee no starres about either Pole alwaies apparant aboue ground, nother all wayes hydde vnder ground, but all starres should ryse and set to all them that dwell about the roller. And againe they that dwell on the flatte endes of the roller, shoulde haue but one Horizont, so large in distaunce of ground, as the whole thicknes of the earthe is: all whiche imaginations are bothe well knownen to be vaine, & also easye to be confuted by the forner reasons, which serue so largely, that you can imagine no forme other then round, but those reasons will confute it. wherefore your argument doth proceede well.

*That the  
water is  
round by di-  
uers protes*

Yet farther for the roundenes of the water also, and name-ly of the sea, you maye frame argumentes by the lyke forme of a ppearances: for where so euer you bee on the sea, you shall see halfe the skye iustlye, and the farther west that you go, the later dooth the Sonne rise: and contrarye waies the farther easte that you saile, the sooner in the morning will the Sonne appeare to you. whereof I will declare vnto you

a no-

a notable example, and a iuste prooffe.

Imagine a ship swift of saile to be at the cape of Cornwall ready to make saile toward the weste directly, and to haue a greate gale of winde, it is possible that she maye run 240 myles in 24 howers: for I haue beene at the triall of a greater course, therefore I speake (as men say) within my boundes: after which rate she shall runne in 16 howers 160 myles. Now let hir hoise saile at the sonne rising, and let the time of the year be somewhat before midsummer, or little after, when the Artificiall day from sonne rising to sonne settinge, is 16 howers longe; by this meanes at the end of 16 howers, she shall be west of the cape of Cornwall where she began her course 160 myles; and then shall the sonne be at setting to their sight that dwell at the saide cape, but the shippe shall haue the Sonne aboue foure degrees hyghe at that instaunte, by reason that she dydde runne with the Sonne, and that the roundenes of the sea doth chaunge the horizont so many degrees in 160 myles.

An exāple of  
the roundnes  
of the sea  
by a ship-  
pes course

Scholar. Althoughe this example bee pleasaunt, yet it passeth myne vnderstandinge, sith that I beleued hitherto, accordinge to your former doctrine, that 160 myles would not haue altered any waies three degrees, seying 60 myles do answere to one degree.

Master. That sayinge is true all wayes for the eleuation of the Pole, for going betwene south and northe in all places, but for going betwene east and weste, it serueth onely for the myddle of the worlde, that is vnder the Equinoctiall circle: and in all other places, the farther you bee from the Equinoctiall, the fewer myles answere to eche degree, by reason that the parallèles growe lesser styll toward the Poles: yet the leaste of theym is dyuided into thre hundred and sixtie degrees as well as the greatest, whereof hereafter I will instructe you more exactelye. in the meane ceason, you shall vnderstande, that for the lati-

M.i.

tude

How many  
myles aun-  
swere to a  
degree at  
the southe  
coaste of  
Englande.

tude of the cape of Cornewalle, euerye degree requyreti  
onlye 37 myles: whiche beyng multiplied by 4, maketh but  
148: and therefore I sayd aboue 4 degrees did answere to 160  
myles, as the truthe is.

Scholar. Nowe I perceauē somewhat better the reason ther  
of by the proportion of the parallele circles in the Sphere.  
and surely this prooffe is pleafante, and easye inoughe to bee  
tried.

A lyke exā  
ple of a ship  
pes course.

Master. A lyke example may this be. Suppose at the same  
tyme of the year when the day is at the longest, that there is  
a swifte shippe at the weste pointe of the isle of Islande, wher  
the longest day is 20 howers from Sonne rising to sonne set-  
ting, in those 20 howers, that shippe might sayle westwarde  
200 myles. Then considering that at that latitude whiche is  
aboue 63 degrees, there answereth but 27 miles to a degree.  
when the ship is at the ende of his course, the sonne will sette  
to them that bee in Islande, and then shall the shippe haue  
the sonne 7 degrees and almost a halfe, aboue the horizont,  
(which maketh halfe an hower in time) so that by the round  
nes of the sea, they haue chaunged their horizont so much  
in twentye howers saylinge. Nowe turne his course and let  
the shippe haue like wind homeward againe the nexte daye,  
and let him make saile at the sonne ryfinge; then shall it bee  
after sonne set halfe an hower, before she shall ariue at the for  
mer porte: by reason that the sonne ryffe halfe an hower  
later to the shippe, where shee was in the weste, then it dyd  
to them at Islande: and therefore muste it set halfe an hower  
rather at Islande, so hathe the shippe loste halfe an hower, by  
comming eastwarde against the sonne.

Scholar. I vnderstand that. As 15 degrees doth answer to  
an hower, so 7 degrees and a halfe maketh halfe an hower:  
wherfore if the shyppe sayle iuste twentye howers, and that  
artificiall daye is iust 20 howers longe, then shall they come  
to their port in Island halfe an hour after son setting, bicause  
it was

it was halfe an hour after Sonne rising in Island, before they began to make saile.

Master. This varietie coulde not happen, except the water also were rounde as well as the earthe. And for farther prooffe of the roundnes of the sea, daily experience doothe teache vs, if we wold diligently obserue it, howe that when a shippe doth draw towarde londe out of the maine sea, the lowe grounde doth not appeare at the firste vnto the shippe but the toppes of high hilles and cliffes: like waies they that be on the londe and looke to the shippe, they see the toppe of the ship firste, and after that, the mastes, sayles, and shroudes before they can see the hulle, and body of the ship. Now I demaund of them that thinke the water to be flatte, what is it that letteth the syghte, so that it canne not as well see the lowere grounde from the shippe, or the hulle of the shippe from the londe?

An other  
prooffe that  
the water  
is rounde.

Scholar. They can name nothing but water: for there is nothinge els betwene them, hable to stay the sight. But then peraduenture they will saye, it is the waues of the sea, whiche rise verye highe often times.

Master. That were to childish an answer, sith the lyke doth appeare, and that most exactlye, in a greate calme, when the sea seemeth as plaine and as smothe as a borde: so that they muste shewe som such thing, as is higher between them then any of both theyr syghts, when the sea is as quiete as can be.

Scholar. Then is there nothinge but water. But then it seemeth to me, that if the water did rise rounde, the farther the shippe were from the lande the higher she should be, and therefore the better myghte be seene.

Master. Your imagination hath small ground of reason: for although the earthe and the water both ioyntlye and severally be rounde of nature, and therefore haue in deed no place hygher then other in their circumference, yet all vulgar men shall thinke by apparance that that place is highest wher thei stand, & that frō them on eche syde ther is a round

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descend

descente, vntill by imagination they come to the right contrary pointe where their Antipodes be; whome they shall think to be right vnder the; wher as those Antipodes haue the contrarye imagination, that they dwell on the highest parte of the grounde, and that their sea is hyghest, and so bothe descendeth compassedlye vnto the contrarye poynte to them againe. and thus euerye other sorte of people think that they dwell on the highest parte of the londe, and also of the sea, (if they dwell on the sea) and they shall thynke that bothe the sea as well as the londe doothe descende from them eche waies. As in this



circularre forme of the earthe and sea; the menne that dwell by A, thinke them selues to dwell hyghest of all other, so that on eche syde of them the londe & sea seemeth to descend, & therefore they iudge the ship that is by B, to bee lower then they, wher as that shippe, contrarye waies, seemeth to them that be in it, to bee on the hyghest parte of the worlde: and therefore they thinke that the londe by A, is lower then they are. Againe they that dwell by C, and the shippe that is by D, are of like imaginations, eche in his fantasie thinking himselfe hyghest, and the other lower. And so of them that dwell by A and by C, eche meruayleth how the other canne go, and his headde downewarde: yet in deede none is lower then other, sith eche of them is equallye distaunte from the centre of the earthe, whiche is the lowest place of all other, and therefore no waye is accompted lower except it be nearer to that centre. wherby also it may appeare contrary to your sayinge, that although the sea bee rounde, yet shall not the ship seem to ascend still, but rather seem to descend, though in deed it doth none of both, but moueth circularly about the centre

centre of the world, so that it can not aptly be called a right motion, but a compassed motion that a shippe maketh, saue that it is tollerably to be borne in vulgare speache, bycause euery small arche of a great circle, seemeth to be a right lyne to the syght of the eye. And in this figure is somewhat represented the declaration how the compassed form of the water doth let the sight to see the ship, and like waies how that they on the londe may se the topp e of the ship when they can not see the hulle, and they in the hulle of the ship can not se those places on the londe, whiche other in the top of the ship may see, by reason that their sight is aboue the height of the water. And this may stande for a conuenient prooffe.

Scholar. So dooth it appeare manifestly, now that my former misconceaued fantalye is reproued. And so I remembre when I haue looked after a shyp that departed from the porte where I stood, first I lost the sighte of the hulle as though it had sonke into the sea, and yet I saw the topp e still: but at lengthe I loste the sighte of it also, as though it had sonke into y<sup>e</sup> water. which by your declaratiō I perceauē doth solow of the roundnes of y<sup>e</sup> water: for other reason I can find none.

Master. Although you could fynd other reasons neuer so many, yet this reason doth enforce that effect. this is y<sup>e</sup> reason that Ptolemy, Cleomedes, and after them Ioannes de Sacrobosco, and other also do alleage, but the same Iohn hathe another reason more physycall thē geometricall, borrowed out of naturall philosophy, which is this: Seing that the water is a body of vniforme substance, the partes of it must be of lyke condition as the whole bodye is: but the partes of water dooth all wayes couette a rounde forme, (as wee see in euerye droppe that falleth from any thinge, or standeth on any thinge) wherefore of iuste congruence the whole body of the sea and water must needs couet the same forme.

Schollar. In deede all droppes that fall from the ayer in a mylde rayne, when menne maye marke it, doo fall in a rounde forme, and so the droppes that fall from the

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caues

A physycall  
reason for  
the roundnes  
of the wa-  
ter.

eaues of the house, or from any thing els, yea and the drops of dewe that stande vppon anye leaues of herbes, or other lyke thinge.

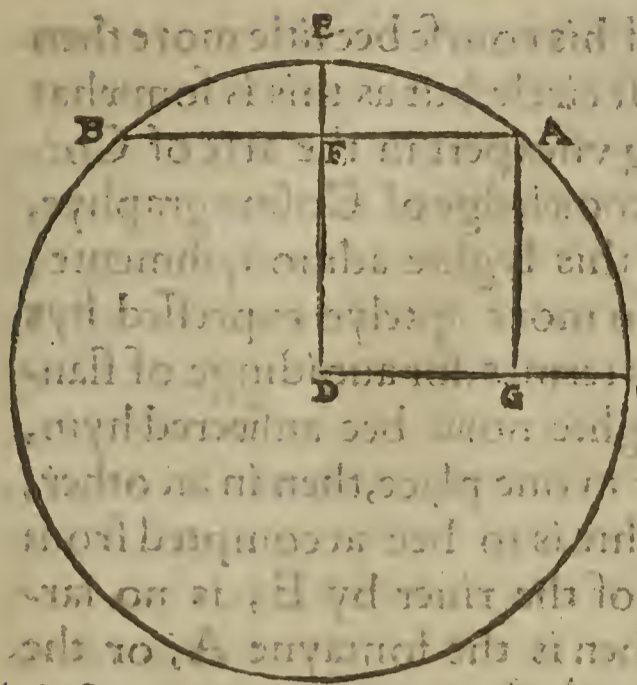
Master. For a farther experience, fyll anye vessell brym full of water, and you shall perceauē by tryall, that the water is higher ouer the myddle of that vessels mouth, then it is by the brimmes. And againe pour out water on a borde or on a stone, and you shall soone see that it will shewe in a round forme, and will be deeper in the middle, then it is by the sides.

Erasmus  
Rheinhold.

Yet farther reasons there be alleged, whiche were to tedious to repeate; but twoo of them I can not omitte, whiche are declared by Erasmus Rheinhold a manne not onely of greate learning, but also of as greate honesty in seekinge to profite all men by his trauaile, although sometime hee wanted leasure to examine some of his writinges, as it may appere by one of those two reasons, whiche is this.

An other  
reason.

By the longe course of euerye greate ryuer (sayth hee) it maye appere that the water doth couet a rounde forme, els could it not so much rise in roundnes, as it doth in running so longe a course. for example he bringeth the course of the great ryuer Danubius, which springeth in the west Moun- taines aboue Vlma in Sueuia, & entrith into the sea Euxine, aboue Constantinople, whiche is from Vlma 312 germanye myles, that is 20 degrees, whiche is the eightenth part of the whole circuite of the earthe: whereby it muste needes folow that the myddle of that ryuer is higher then the fountaines or the mouthe, by 13. germanye myles (that is 52. englyshe myles) in plumbe heighte. for declaration whereof hee maketh this demonstration linearye, supposynge A E B C, to be as one of the greatest circles about the earthe, whose centre is D. this circle must be imagined so to passe agreably to the course of Danubius, that A maye represente the fountaines of it, and B the mouthe of it, so E shall stand for the myddle parte of the riuers course, and A E B, for the whole course



course. Now is it sayd before, that betwene A and B are 20 degrees, then if you draw a right line from the one to the other, as heere you see AFB, it will be lower vnder the myddle of the arche, by the length of the line EF, which is almoste the 60 parte of the semidiameter of the earthe, and maketh iustlye 52 english myles, sumwhat lesse then 57: which is the 60 part of the semidiameter of the earthe.

Scholar. This reason seemeth pleasaunte, but I perceauē not the reason of the iuste quantitie of the lyne EF.

Master. That dependeth of the arte of Sines and Cordes and is very certaine without any sensible error, of which in an other place ye muste learne the vse. And in deed as you saye, this reason is pleasaunt, and the author muche to bee praysed and loued, and as muche is it to be lamented, that the shortnes of his life would not permitte him to haue recognised his workes againe: wherfore that he can not do by preuention of deathe, I truste some of his friendes will do: for althoughe they be but litle faultes, yet pittye it is that in so good woorkes there shoulde remaine any litle sportes, as in this argument there are two, which yet hinder not the argument. And althoughe it might bee truly sayde that the heighte of the myddle of Danubius is not 52 myle, and is but 36 mile, yet is the forme of his argumente good, for that height is sufficient to proue that the middle appeareth muche higher then the fountaines of it: the cause of this ouerlyght was, that hee did esteeme the course of Danubius to runne by one of the greatest circles of the earth, which is not so: for it hath in latitude from the equinoctiall 46 de-

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grees

grees, so must the parallele of his course be little more then two third parts of the greatest circle: but as this is somewhat to straunge for you yet beyng vnexpert in the arte of Cordes and Sines, and in the knowledge of Cosmographie, so I wyll lette it passe with this lyghte admonyshmente, wysshyng that hee hadde also more aptelye expressed hys meanynge, and the vse of his termes, for auoidinge of slanderouse tongues, for it myghte nowe hee answered hym, that Danubius is no hygher in one place, then in an other, seeynge all distaunce of heighte is to bee accompted from the centre: and the middle of the riuer by B, is no farther from the centre D, then is the fontayne A, or the mouthe B.

Schola. Marye that obiection is certaine, and therefore is his errour manifest, and his argument of no force.

Erasmus  
Rheinolt  
excused.

Master. You triumphe to muche before the victory. his argument is better then you do considre it: his intent was to proue that the water doth not run by a right line and downward still, as the vulgare sorte doothe imagine, but that it runneth circularlye. wherefore it soloweth well against the vulgare opinion, to say that the water of Danubius is hygher in the middle of this his course, by so manye miles in height plumb vpright, then it shuld be by their imaginatiō. So is there none other fault in this point, but the want of distinction of the true opinion of highnes and lownes, from the wronge takinge of the same names, wherby those which do not know his great learning, and myght happen to hear his argument, wold iudge that other he were wonderfullye deceaued, other els that he did to much abuse hys tearmes: but if deathe hadde not preuented him, hee woulde haue declared his meaninge, I doubt not, as I haue declared it.

Erasmus  
Rheinolt  
his seconde  
argument.

Nowe to hys seconde argument. he proueth that there can be no such holownes in the sea, as there is betweene two hylles: for seeynge the sea is a heauye bodye, and presseth towarde the centre of the worlde, euerye parte of it will

myll doo the lyke if it be not stayed. And the water beyng a lyquide and fluxible bodye, can not be stayed by his owne partes: wherefore it foloweth that there can remaine no valleys nor dales, nor hollowe partes in it, but it shall quickly be fylled with water, and therefore wee see, that nothinge can be more plainer then is the toppe of water, syth every part so exactly ioyneth with other, in fyllinge vp all vnequalitie: whercof it foloweth, that if the toppe of the water be iuste equall and lyke distaunte from the lowest part of the world, (which hath been often declared to be the centre of y<sup>e</sup> earth) then muste the face of the water needes be round, according to the definition of a circle.

Scholar. That foloweth well in deede: for as ec he parte of the circumference in a circle is equally distaunt from the centre, so if all partes of the face of the water be equally distant from the centre, it must needes be circular, as the circumference of a circle is. But if it be so round, and ought to haue his place aboue the earthe, how doth it happen that it doth not couer the whole face of the earthe, and so shoulde there be no earth seene.

Master. Haue you forgotten what you readde in Ioannes de Sacro Bosco, for to answere that question?

Scholar. In deede he sayth that the other three elementes doo compas the earthe round about, saue that for the preservation of man and beastes, the drinesse of the earth doth withstande the moysture of the water.

Master. That reason fauoreth more of the determinations theological, then of the demonstrations mathematical; wherefore I will adde therto a proof by good demonstratiō that it can not compasse the earthe rounde: for whiche purpose firste I saye, that the water beinge inclosed within the boundes of the earthe, can not be so greate as the earthe is. Againe considering that one portion of water being mixed with 4 tymes so much earth, wold make it all softe and flabby, it may not be thought that the water of the sea and of

Why the  
water doth  
not couer  
all the earth.

That the  
water  
I.  
can not compass the earth  
II.

all

III. all ryuers and springes ioyned together, is so muche as the firste parte of the earthe. Farthermore if you consider the firme stablenes of the earthe, and the vnstable swaruyng of the water, you wolde thinke that if the water were able to matche the twentieth parte of the earthe, it woulde make the earthe more vnstable then the nature of the earthe, and the preservation of earthly creatures could beare. Yea it would be a weak ground to bear so wondrefull a waight as it doth, if the quantity of water were notable, in comparison to the quantity of the earth. Yet now for farther triall, suppose (as I thinke it true) that on the flatte face and circumference of the earthe, there is as muche water as londe, so mighte it appeare that the water were as muche as the londe, as manye men doo affirme.

Scholar. And mooste part of learned men (as I haue heard say) do vouch that as a mooste certaine truthe.

Master. It is true, as I iudge also, yf they meane lyke cosmographers that halfe the face of the earthe (as I sayde) is couered with water, but then imagine what depthe maye that sea be of.

Scholar. No manne can tell.

Master. Yet by triall of mariners it hath been founde in fewe places, a hundreth fathomes deepe, whiche is litle more then the tenthe parte of a myle.

Scholar. That not withstandinge, it maye bee deeper in some places.

Master. For a supposition, imagine it were in all places a myle deepe, takinge one place with an other.

Sch. I thinke that to to muche a great deale, consideringe that all knowen partes are not in the deepest, accomptinge one place with an other, as good mariners can testify, aboue 40 fadome, and so groweth shallower still to the shore.

Master. The more that that supposition exceedeth truth, the stronger shall the prooffe be of the smalnes of the water in comparison to the earthe.

Schol.

Scholar. Then for trials sake, I suppose it were so.

Master. How deepe thinke you now the earth to be?

Scholar. I remembre you saide before, that 57 myle was but the 60 parte of the semidiameter of the earth; then must the whole earth be in thicknes 6840 myles.

Master. That is agreable to that rate; but as I sayde before, the diameter is 6872  $\frac{8}{11}$ . And nowe if you abate one fifte parte of that depthe, the rest will make the side of a cubike forme, almoste as great as the globe of the earthe; as it appeareth in the workes of Geometrye.

Scholar. The fyfte parte of 6872 is 1374, which beyng deducted from 6872 there resteth 5498.

Master. That numbere is somewhat to lyttle, but 5541 is very nigh the side of a cube, equal to the globe of the whole earthe, therefore multiplie it cubikly, as you haue learned in Arithmetike, and then shall you see, howe manye miles square are in the whole globe of the earth.

Schol. If 5541 be multiplied by it selfe, it maketh in square numbere 30702681, which being multiplied again by 5541, doth yeld 170123555421: which is the cubike numbere to 5541, and so consequently must it be that cube whiche is equall to the earthe, in his whole globe.

Master. So is it very nigh. But now for the quantite of all the sea, this way must you worke. Firste to know all the plat face of the earth, you must mul

tiply his circumference by his diameter, as it is declared in the Pathwaye, and so will there amounte 148450909: whiche is the full platte forme of all the face of the earth: wherof presupposing (as the truth doth inforce vs) that halfe the same is sea and water: then dooth it followe, that the whole platte face of the sea and water is

74225454 myles and a halfe in all together, which is not the 2000 parte of the earthe.

Scholar. But muste not this numbere be multiplied by the depthe of the sea?

Master. Seynge that depthe is not in one place with an other aboue one myle; and i dooth nother multiplie nor diuide, it will remaine as it is.

Scholar. Then dare I thinke farther, that the depthe of the sea beyng not a quarter so muche generallye, the earth must nedes bee 10000 tymes so greate as the sea, and all other waters.

Master. Your woordes erre not muche from the truth; and therefore by this reason it doth appear, that the water being so little in comparison to the earth, can not aptlye compass the earthe. And by this it appeareth also how childishlye they doo erre, that thinke the water to bee tenne tymes so greate as the earthe: for if it were but twise so greate as the earthe, it muste of necessitye couer all the face of the earthe: yea I will saye constantlye, if all the water were as muche as the hundreth parte of the earthe, it would ouer runne all the earthe, and couer it cleane: whiche I maye easilye prooue, but not brieflye: and secyng the same thinge is all readye declared in the Pathwaye, I will omitte it heere, syth it is a more appropriated prooue for Geometrye; then for Astronomye: and nowe will I returne to the prosecutinge of our former matters, accomptyng this sufficiente for the declaration of the roundnes of the earthe and also of the water seuerallye. and now wyll I adde one reason to approue that bothe they do make one perfect rounde globe.

That the  
earthe and  
water to-  
gether doo  
make a per-  
fect globe.

Euerye grosse and sounde bodye doth gyue a shadow like vnto his owne forme: the earth is a grosse and sound body, therefore muste it gyue a shadow lyke hys owne forme: but in all eclipses of the Mone, which are caused by the shadow

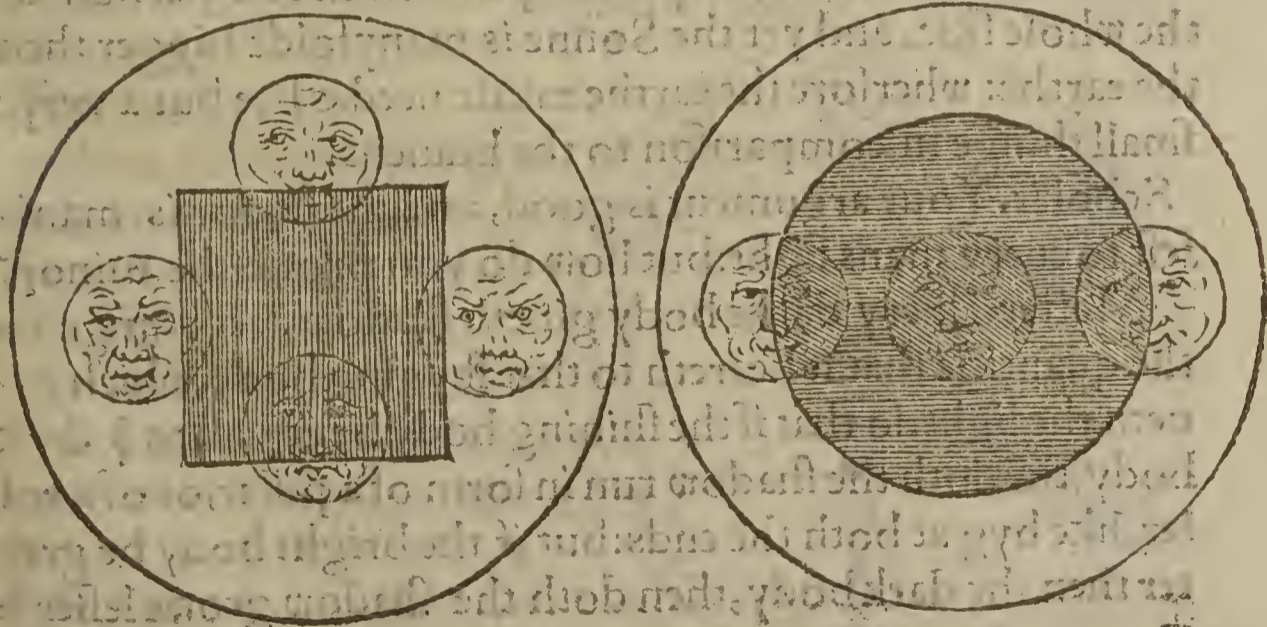
of the earth, his shadowe is alwaies constantly round, whether the shadow doo runne easte, weste, southe, or any other waies mixtly: wherfore it foloweth, that þe forme of the earth is round, whiche giueth that rounde shaddow.

Scholar. How shall a man vnderstand that the shadowe of the earthe is rounde?

Master. In the eclipse of the moone, other all the mone is darkened, or els but one part of hir: If all the mone be darkened, then doth the darkenes begin on the easte syde of the moone in circularre forme; and encreaseth still in the same forme, tyll all the whole moone be eclipsed, and then decreaseth the darkenes againe, so that the weste syde of the mone is darkened, but the darkenes vadeth by lyttle and litle, and yet styll in circularre forme. And if the moone be darkened only in one parte; whether it be the south part, or the north parte, yet still is the shadowe round in forme: where as if the earthe were square or cubike, other three cornered, or of other suche forme, the shaddow wolde so appear in the mone as by the thirde and fourthe figure, you maye partlye perceauce.

Examples of the firste forme where all the moone is eclipsed at the full eclipse.

Example of the thirde and fourth formes.

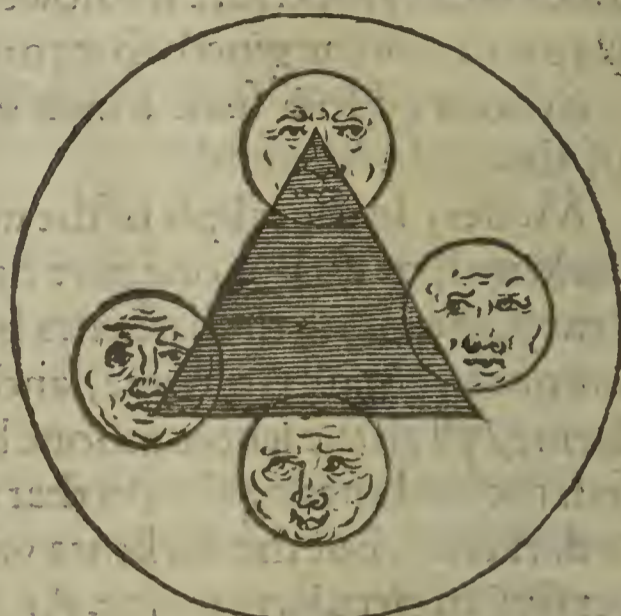
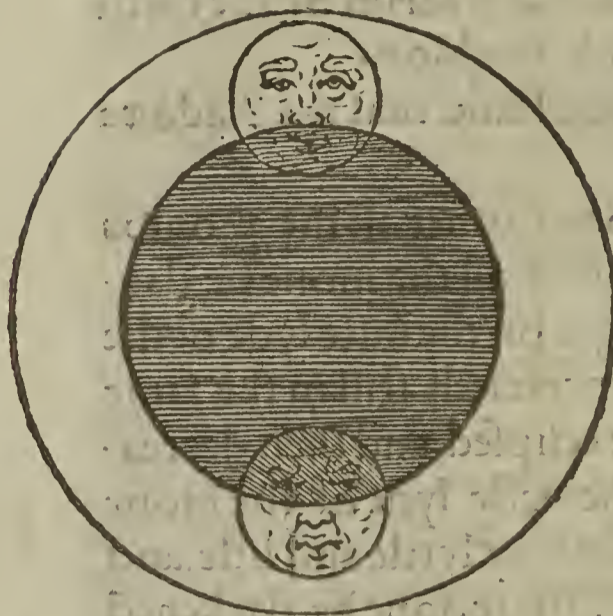


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But

Examples of the thyrd and fourth  
formes.

Examples of the other two sortes, of one  
parte eclipsed.  
The southe parte.



The northe parte.

That the  
earth is but  
a pricke in  
respekte of  
the skye.

But I will omitte this matter tyll anone, bicause it is not easye to vnderstande without farther explication of other matters incident therto. And bicause I haue begon to speak of the shaddowe of the earthe: I will alleage one argument more, taken by the same shaddowe to approoue the smalnes of the earthe in comparison to the skie. wherfore thus I frame mine argument.

The Sonne is but a very small portion in comparison to the whole skie, and yet the Sonne is manyfolde bigger then the earthe: wherfore the earthe muste needs bee but a verye small thinge in comparison to the heauens.

Scholar. Your argument is good, and the maior is manifest to euery mans sight: but how do you proue the minor?

Master. Euery darke body giueth shadow accordinge to the quantitie that it beareth to that shyning body, which giueth the light; so that if the shining body be equall to þe dark body, thē doth the shadow run in form of a piller, or of a roller, like byg at both the ends: but if the bright body be greater then the dark body, then doth the shadow growe lesser & lesser

lesser in spyre forme, or taper fashion, and at lengthe doth ende in a sharpe pointe. Contrarye wayes, if the lyghte bodye be lesser then the darke bodye is, then doth the shadow grow greater and greater, still as it goeth from the dark body, and is smallest at the beginning, contrary to the taper forme, whiche is greatest at the beginninge: and this forme maye be called maundforme, or bell forme, bicause it is like a maunde basket, or a bell.

Examples of these thre diuers shaddowes.

The Piller forme.



The Taper forme.



The Bell forme.



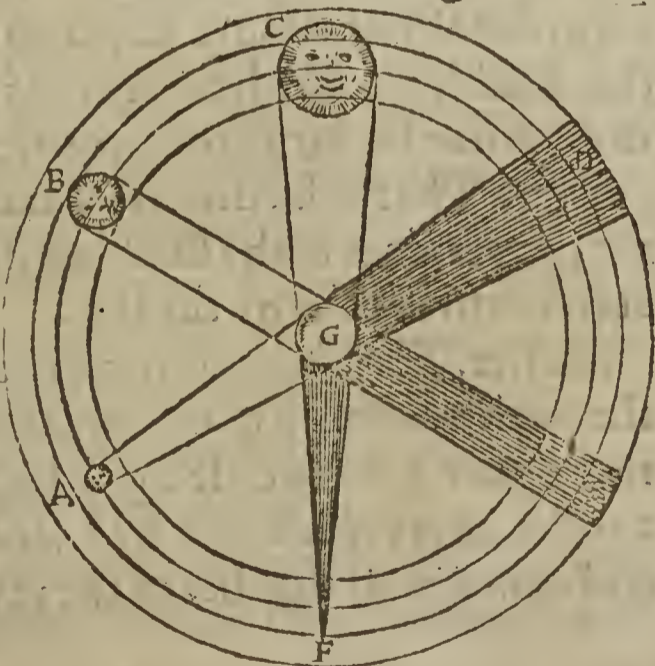
A representeth the son or other lyght body. B the earth, or any dark body, and C the shadow.

Scholar. This may stand as a sure maxime, sith both reason & sense doo testify it to be true.

Master. Then do I infer farther: that if the sonne were

lesser then the earthe, the shadowe of the earthe would grow greater and greater, and would be infinite in lengthe: where

by it wold darkē the most parte of the starres, euery night: & very often it wold shadowe the mone, and that for a lōg space together. as you may gather by this figure, wher A representeth the son in lesser form then the earth, which is signified by the circle marked with G, & the shadowe that cometh by this form, is marked with



D, which occupieth a great part of the skye, and therefore

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woulde darken all the starres in so much space of the skye, which is nyghe hande a quarter of that hemisphere that is aboue our horizon. And as the shaddow tourneth about accordyng to the motion of the Sonne, so in four and twentye howers all the starres that be nyghe vnto the zodiake, should suffre eclipse: whiche thinge is contrary to dayly experience, for wee see there (about the zodiake and againste the sonne) the starres very bright.

Scholar. This reason doth suppose, that the starres do receaue their light of the sonne, which thinge was not yet proued by you, althoughe I thinke it to be true, yet in a good argument, no doubtfull sentence may be alleged.

Master. Then seing this place doth not conueniently permit so longe a digression to prouue that, I will vse the mone for an example, which appeareth so manifestlye to borrowe her lyghte of the Sonne, that according as she receaueth the lyghte from him, so dooth shee appeare greater or lesser in lyght, according to hir distance from him. and when so euer she commeth into the shaddowe of the earth, she leeseeth her lyght, other fully or in part, accordingly as she passeth and toucheth the shaddowe of the earthe. wherefore as longe as the moone shoulde be within that shaddow, she must needs be in the eclipse: and the shaddowe beinge so great, she shuld be eclipsed not only euery moneth at the full, but she should continue almoste foure dayes to gither in that eclipse, seing that shaddowe dooth occupye as muche of the skye, as shee doth moue by hir propre course in foure dayes.

Schol. That absurditie is to manifest to graunt vnto: and yet the greatnes of the shaddow inferreth no lesse, syth it occupyeth so muche of the skie.

Master. The like inconuenience will follow, if the son and the earth were both of one greatnes, as are B & G in the former figure, for so wolde the shaddow run of one bignes like a roller, as is represented by E, and wold darkē diuers stars, and namelye all that bee in the myddle of the Zodiake, and the

the moone should both oftener be eclipsed (then in deed she is) by the greatnes of the shaddowe, and wold tarry longer in the eclipse, by that same reason, then good reason wold allowe. But seing we perceauē no starres directlye against the sonne to be eclipsed, nother yet the mone, in suche forme as that pyllerlyke shaddow would cause, we must needes thinke that the shaddowe is muche abated, beefore it come to the sphere of the moone, and is cleane consumed before it come at anye of the starres, whiche kinde of abatement could not be, but where the light is much greater then is the body that maketh the shaddow, as is C in comparison to G.

Scholar. So must it followe, that seying the Sonne is the lyghte body, and the earthe giueth the shaddowe, of necessitye the Sonne muste be greater then the earthe.

Master. Yea in deede, and that manye folde.

Scholar. Then of more force muste the earthe bee a verye small body in respecte to the whole skye, which is infinitely greater then the sonne, as euery childe may perceauē.

Master. Yet haue I farther matter of profe, that the earth is not only a very small bodye in regarde to the skie, but is without anye vewe of greatnes in that comparison.

If the earthe had anye notable quantitye in respecte of the skye, then muste the diameter of the earthe haue as greate a quantitye, in comparison to the diameter of the skie. for as in twoo circles the proportion of the diameters is equall to the proportion of the circumferences, so is the proportiō of the shorter to the longer, greater then is the proportion of their two platte formes: but in two globes the proportiō of the shorter diameter to the longer, is muche greater then is the rate of their platte formes: and yet muche more greater then the proportion of the lesser globe to the bygger.

Scholar. That is sufficiently proued in Geometry, wherefore you may proceede with your conclusion.

Master. If the diameter of the earth haue notable quantity in cōparison to the diameter of the skie, then the stars which

*The second  
reason for  
the quanti-  
tie of the  
earthe. Cc*

N.ij.

are

ar ouer our headdes, be nygher vnto vs by a notable quantitie, then when they be in the easte, or in the west.

Scholar. In deede they are nearer by the semidiameter of the earthe: whiche of it selfe muste needes bee accompted a notable quantitie.

Master. But if it shall be so accompted in regarde to the halfe diameter of the skie, then must the stars ouer our heds seeme bigger by a notable quantitie, then when they are in the easte or weste.

Scholar. That reason is, not only approued by Geometrye, but also by cōmon sight and daily experience, that the nigher any thing is to the sighte, the greater it seemeth; and the farther from the sighte, the lesser it sheweth.

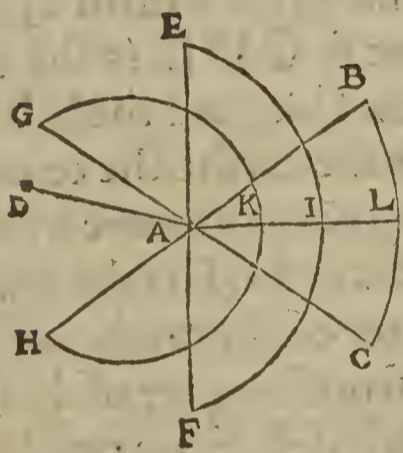
Master. There is no suche diuersity perceaued in the quantitie of the starres, but that they appeare styll constantly of one bignes: wherfore it must follow, that their distance is all one in all partes of the skye, and then doth not the semidiameter of the earth make anye notable diuersitie in distance: wherfore it must be thought that the quantitie of it is not sensible in comparison to the semidiameter of heauen, nother the circumference of it in comparison to the circumference of the skye, and muche more may not the whole quantitie of it bee accompted sensible in respecte to the whole quantitie of the worlde.

Schol. That foloweth well: for as I learned in Geometrye, if the diameters of any two Globes, be in suche proportion that the greater do contain the lesser a thousand times, then be their circumferences in the same rate: but the platte forme of the greater, is 1000000 folde greater then the lesser: and the whole substance of the bigger globe, doth containe the smaller globe, 10000000000 tymes.

Master. Vndoubtedly it maye bee perceaued by sight as well in dialles, as other greater instrumentes made for obseruations, that the semidiameter of the sonne his sphere is more then a thousand times longer then the semidiameter  
of the

of the earthe, els wolde not the shadowes agree so exactly as they do: for they moue as duely and ordrely about the centre of all suche instrumentes, as if their centre were the very centre of the world. which thinge could not be, if those two centres dyd differ notably; in respecte to the sphere of the Sonne. And if it were not, that an introduction dooth not admitte the exacte proofes of the arte, I could herby declare the proportion of these two semidiameters so exactly, that you should confesse that prooffe to bee righte certaine and good. But now wil I procede to the declaration of this third reason by linearye demonstration; although it be somewhat obscure, without other helpe.

In this figure, which representeth the three notable circles



in a diall, that bee made by the course of the Sonne, in the three

*The thirde reason.*

notable places of the zodiacke, that is in the two tropikes and in the equinoctiall, the vttermoste arke B L C, representeth the tropike of Capricorne, and is heere made no bygger, then the quarter of a circle, bycause the Sonne doth shine but syxe howers vnto vs, when hee is in

the signe. the equinoctiall is set as halfe a circle, bicause the son being in it, doth shine to vs 12 howers, and is here limited by E I F. The tropike of Cancer containeth thre quarters of a circle, bicause that when the Sonne is in it, then is there 19 howers from Sonne rising to sonne setting: and that circle here is signified by G K H. The centre of this diall is A, and the stile that giueth the shaddow is D A, whose toppe being D, doth describe those cantylles of circles, in suche precisenes, as if that diall stood in the centre of the earth. and like waies the distinction of the howers is suche exactlye in that diall, as if the centre of the diall, wer the very centre of the world.

N.iiiij.

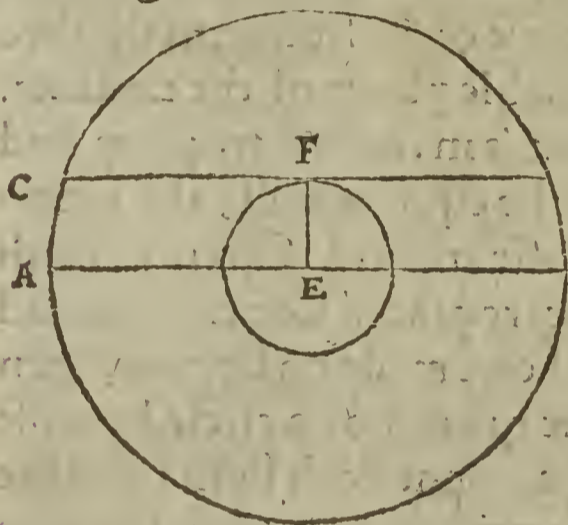
Schol.

Scholar. I do conceaue good reason of profe hereby, but yet I thinke I shall perceaue muche more, when I shall vnderstande the iuste vse of those dials, as well as of other seuerall instruments of lyke vse.

Master. You say truthe: and therefore wyll I passe from this thirde reason, and come to the fourthe prooffe, whiche is thys.

*The fourthe  
reason for  
the smalnes  
of the earth.*

If the earthe were of anye bygnes in comparison to the worlde, then shoulde his semidiameter beare some vewe of byggenesse to the semidiameter of the skie. and so consequently the horizont that we haue on the ouer parte of the earthe, should not diuide the skie into two equall partes, for that part which shuld be vnder the horizont, would alwaies be the greater, and the lesser parte aboue the horizonte, as



in this figure it doth appear. where  $A C D B$  is the circle of the skie, and the lesser circle is the earthe, the centre  $E$ , being cōmon centre to them bothe. and  $E F$  is the semidiameter of the earthe, as  $E A$  is  $\frac{1}{2}$  semidiameter of the skye. Nowe if  $E F$  bee notable in quantitie in comparison to

$E A$ , then will the line  $C F D$  (beyng the horizont on the toppe of the earth) differ notably from the line  $A B B$ , beyng the diameter of the worlde, and the horizont to the centre of the earthe. And so shall not that horizont  $C F D$  diuide the worlde into two equall halues, but the ouer part aboue the horizont shall be lesser then the other parte that is beneth the same horizont, whiche thinge is contrary to daily experience, and to all obseruations: for we may see in the longe winter nights those starres that be in the horizont in the easte at the beginning of the nyght, to be in the same horizont in the weste, at the ende of twelue howers; and contrarye

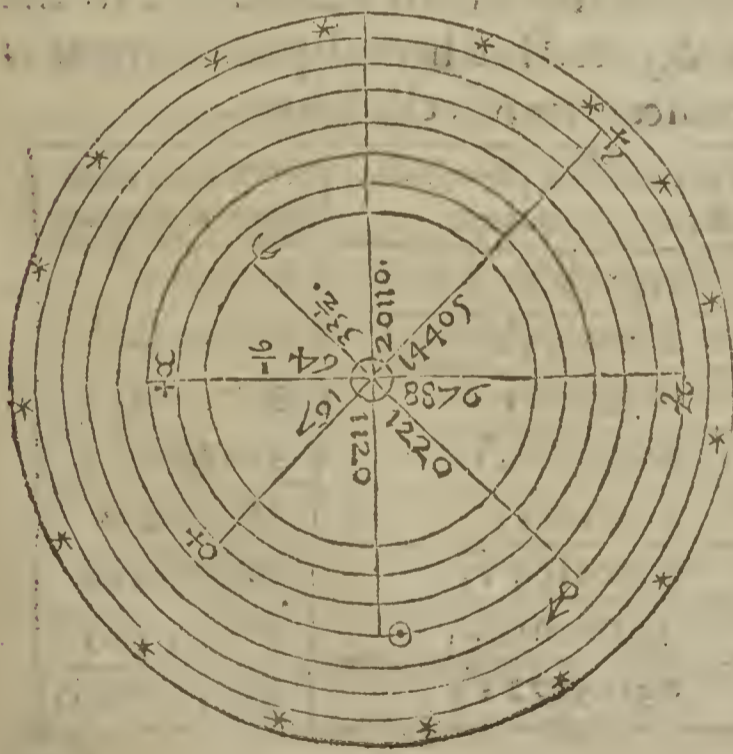
trary waies those starres that did set in the west, when those other did rise in the east, shall rise againe when the other do set. And so of the sonne and the moone when they be in contrary pointes of the Zodiacke.

Scholar. That is at the full of the moone.

Master. In deede then are they right opposite the one against the other; but if the moone be at the full, long before the sonne setting, then will she rise somewhat after the same; and contrary waies if she be at the full after the sonne setting, then will she rise somewhat sooner, by reason that she moueth eastwarde euery hower 33 degrees. And although vnto them that be meanly acquainted with the motions of the planets, the declination of the moone and hir latitude, may occasion some doubtfulness to rise, yet vnto the learned, those many folde varieties in the motion of hyr and thother planets; do confirme the principles of astronomy more aduredly: but this will I omitt tyll an other more conuenient tyme.

Scholar. This is well proued nowe, that the earth in comparison to the whole world is but as a pricke or a mote, and lyke waies in comparison to the other spheres.

Master. You muste except the spheres of the thre planets whiche bee beneth the son. for vnto them the diameter of the earthe beareth a notable quantity: for the semidiameter of Venus Sphere, is but 167 tymes so long as the semidiameter of the earth; and the semidiameter of Mercury his sphere is shorter muche, for it is litle more then 64 times the semidiameter of the earthe



earthe, but the moone hath hir semidiameter only 33 tymes and a halfe longer then the earthes semidiameter: all which proportions with the residue, I haue set forth in this figure, wherby you may perceauē, that vnto  $\frac{1}{2}$  semidiameter of ech sphere, is annexed the numbere that importeth howe often it containeth the semidiameter of the earthe. that is to say: the sonne his semidiameter containeth it 1120 tymes, Mars 1220 tymes, Iupiter 8976 tymes, Saturne 14405 tymes and the eight sphere or starry skie. 20110 tymes.

Sch. I remembre that Faber on the Sphere doth accompt those distances by miles, which is a pleasant matter to read.

Ma. In that place Faber foloweth the accompt of Alphraganus the Arabitian, which speaketh of myles much longer then the Italian myles be: for 6 of the Italian miles do make but 5 of Alphraganus miles: of which diuersity at an other tyme I will instructe you, namely in the treatise of Cosmographie: where I wyll set forth diuers varieties and apperante repugnances of sondry writers, for the measuringe of the earthe: and proue it to be a disagreement more in wordes then in meaning: and to come by reason of their diuers miles, or other inconstant measures. And bicause you like that table so well, lo heere is an other drawen accordinge to the rate of 60 myles to eche degree. But heere by the compas is vnderstande the inner concauitie of eche sphere.

The eyght Spheres.	The myles that theyr semidiameter containeth.	The myles of euery sphere in compas.
☾ The Moone	115278.	724604 $\frac{4}{7}$
☿ Mercurye.	220500 $\frac{2}{3}$	1386000 $\frac{4}{3}$
♀ Venus.	573872 $\frac{8}{11}$	3607200
☼ The Sonne.	3848367 $\frac{1}{11}$	34189737 $\frac{1}{7}$
♂ Mars.	4192363 $\frac{7}{11}$	26352000
♃ Iupiter.	30501163 $\frac{2}{11}$	191721600
♄ Saturne.	49500818 $\frac{2}{11}$	311148000
The eight sphere.	69105272 $\frac{8}{11}$	434376000

And

And his conuexitie or ytter compas is equall to the concauitye of the nexte sphere aboue it.

Scholar. If the whole circuite of the skye bee 434376000 myles, and the same compasse is 360 degrees, then muste it needes follow, that euery degree of that sky contayneth iust 1206600 miles, as by diuision it may be sufficiently well proued. But howe is this supposition of distaunces approved to be true?

$$\begin{array}{r} * 23 \\ 434376000 \\ \underline{1206600} \\ 3665660 \end{array}$$

Master. That profe dependeth of more knowledge, then this introduction teacheth, and therefore must be referred to a higher treatise. But in the meane season admitting this supposition, you maye easilye tell, howe manye myles the sonne and the moone are in breadthe, seeinge eche of them is accompted about 31 minutes by theyr diameter, eche in the myddle of his owne sphere.

Scholar. Nowe I vnderstande the forme of woorkinge for tryall of this matter. Fyrste I muste searche how manye myles make a degree in eche of those spheres, and then take a parte proportionable of that nūbre agreable to 31 minutes & a halfe. Therefore to begyn with the sonne. As his whole sphere in the middle is in compas 25270869 myles, so tryinge it by diuision, I fynde that euerye degree in that sphere doth containe 70197 miles nygh hande. Then say I by the golden rule, if 60 minutes (whiche make one degree) do require 70197, what doo 31 and a halfe make? After iuste multiplication and diuision, as that rule dooth importe, I fynde the whole diameter of the sonne to containe in myles, 36853: where as the earth (as before is noted) dooth containe in his diameter but

$$\begin{array}{r} * 23 \\ 25270869 \\ \underline{31\frac{1}{2}} \\ 70197 \end{array}$$
  

$$\begin{array}{r} 60 \\ 31\frac{1}{2} \end{array} \begin{array}{r} 70197 \\ \hline 35098\frac{1}{2} \\ 70197 \\ \hline 219591 \\ 2211205\frac{1}{2} \end{array}$$
  

$$\begin{array}{r} * 53 \\ 2211205\frac{1}{2} \\ \underline{666660} \\ 36853 \end{array}$$

but 6872 myles. So that therby it appeareth, that the sonne is more then 5 tymes so broade as the earthe is ouerthwart.

Master. That is well limited. for els if the flat of the greatest circle of the whole earthe myght appeare vnto vs, as the flatte forme of the sonne doth, the flatte forme of the sonne ought to be accompted about 29 tymes so great as the earth is, in lyke forme. And the whole globe of the sonne muste needes be about 155 tymes so greate as the earth in his whole Globe.

Scholar. I perceauē that dooth followe by twoo rules of Geometrye, wherof the firste is this.

In what proportion so euer the sides of any twoo squares be, those squares are in the square of that proportion: so that if the sides be as 2 to 1, the squares are as 4 to 1: and if the sydes be as 3 to 1, the squares are as 9 to 1. &c. The seconde rule is this: In what rate so euer the sydes of any cubes be, the cubes do beare the lyke rate cubikly multiplied, as if the sydes be as two to one, the cubes are as 8 to 1: and if the sydes be as thre to one, the cubes are as 27 to 1. &c.

Master. This is well applied of you, that you can frame your common rules in Geometry to suche speciall matters. And nowe may you proue the lyke in the moone.

Sc. You say, that the circumference of the sphere of the moone is 724604 myles, and  $\frac{4}{5}$ : then diuidyng it by 360, ther wil amount the quantitie of one degree: whiche yeldeth in this rate 2012 myles and  $\frac{3}{5}$ : but accomptinge the breadth of the moone 31 minutes and a halfe, the myles that answere vnto it, are but 1057: wherby it foloweth, that the diameter of the earthe being 6872, is 6 tymes and a halfe greater then the diameter of the moone. And therefore the flatte of the earthe in his greatest circle, is aboue 42 tymes so greate, as the like flatte forme in the moone: and the whole globe of the earth is 273 tymes so greate, as the whole globe of the moone.

Master. In this accompt you take the innermost circumference of the sphere of the moone, and in the like accompt

nanye

manye other take the vttermoste circumference, but it appeareth more reasonable to take the myddle distaunce betweene them bothe, whiche is 1055302. (as here by example dooth appeare) and in that place of distaunce to take the rate of hir diameter.

$$\begin{array}{r} 1386000 \\ 724604 \overline{) 2110604} \\ \underline{2222} \quad 2 \end{array} \quad (1055302$$

Scholar. So it seemeth most indifferent reason. And then the measure of one degree wyll be 2931  $\frac{7}{8}$  and of that there will aunswere to the diameter of the moone (being accompted 31 minutes and a halfe) 1539 myles. Nowe if I diuide the diameter of the earthe (whiche is 6972) by it, there wyll be in the quotient 4 and a halfe almost: so wyll it appeare that the diameter of the earth is 4 times and a halfe almoste so longe as the diameter of the moone: and the flat of the earth 20 times so large as the flat of the moone. And the whole earthe nynetye tymes so greate as the globe of the Moone.

Master. Yet according to the common accompt, the earth is but 39 tymes so muche as the moone: but hereof and of many other thynges that seeme aboue the reache of mannes witte, I will an other time instructe you farther. for it is no meete mater for an introduction. And thys is broughte for exammples sake onelye, that you myghte vnderstande the ordre of suche sorte of woorkynge, and therby learne to trye your authors sayinges. But nowe it is tyme to proceede to other matters, and to declare the true place of the earthe, and to prooue that it standeth in the myddle of the worlde, whiche thinge althoughe it may sufficientlye bee gathered by that that is written beefore, yet I wyll declare certayne inuincible reasons for confutation of them that mysseplace it. And to begyn with all, there can be but three dyuersities of places in generall, without the centre of the worlde: for other it muste bee beside the Axe tree of the worlde, and yet equallye distaunte from bothe the Poles, or els it muste bee on the Axe tree of

That the  
earthe is in  
the middle  
of the  
worlde.

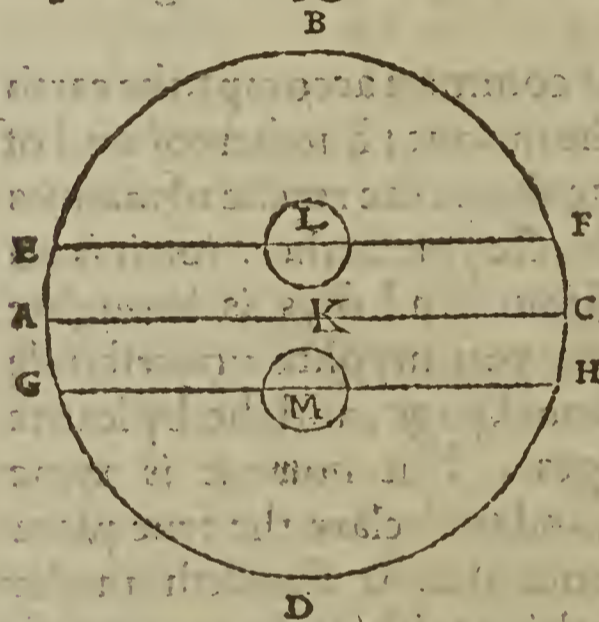
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the

the worlde, and yet nearer to one Pole then to an other: or thyrdlye it muste bee beside the Axetree of the worlde, and also nearer to the one Pole then to the other. beside these three varieties there is leste but one more (whyche is the true placynge of it) and that is to be on the Axetree of the worlde, equallye distaunte from bothe the Poles: wherefore if the firste three opinions bee reprovued as false, this fourthe must needes remaine as onely true. And nowe for the confutyng of the three fyrste opinions: I will vse Ptolemyes argumentes, augmentyng them with a larger explication.

*The confus  
tatiō of the  
first opiniō*

If the earthe were out of the centre of the worlde, and yet stode in the middle betweene bothe the Poles, then shoulde not the Horizonte cutte the skye into twoo equall halues. And thereof woulde followe, that in the righte sphere the daye and the nyghte shoulde not be of one lengthe. As for



example: If you would imagine the earthe to stand as *L* dooth in this figure, then woulde the Horizonte be the righte line *E L F*, and so the parte that is vnder the Horizonte is greater then the other parte of the skye aboue the Horizonte: wherefore in the ryghte Sphere the nyghte muste needes alwaies be longer then the daye: but if you would imagine the earth to stand where *M*, is set vnderneath *K*, which is the verye centre of the worlde, then woulde that Horizonte *G M H*, whiche answereth to that centre, be vnder the true horizont of the centre of the world, that is the right line *A K C*. And so shoulde the nyghte alwaies in the righte sphere be shorter then the daye, bicause the greater parte of the skye is aboue the Horizonte, and the lesser parte vnder

der it. And by the like reasons in al other bowing sphiars ther shoulde bee no equalitye betwene the daye and the nyght: and if there were any, it should not be in that time when the sonne were in the iuste middle betweene the twoo Tropikes, (that is vnder the Equinoctiall line) bicause that the Equinoctiall line is not equally parted by the Horizont, but the greater parte is aboue the Horizont, after the one supposition, and after the other supposition it is vnder the Horizont of the earthe.

Scholar. This I doo vnderstande well, accomptinge the circle A B C D, to represent the Equinoctiall lyne.

Master. And farther you may perceau (as all men, in all ages, and in all nations do confesse) that the increase of the dayes from the shortest to the meane, and from the meane daye to the longest are not onlye agreeable betwene themselves, but are lyke also exactlye to the decrease of the daies from the longest to the meane, and from the meane to the shortest. whiche thyng coule not bee, excepte that the myddle circle betweene the twoo Tropikes (whiche is ryghtlye called the Equinoctiall circle) were equallye diuided by the horizont into twoo iuste halues. And farther: seeyng there can be no position of suche obliquity (except it be righte vnder the Pole) but some one circle of the Sonnes course must be diuided equallye into two partes by the Horizont, so that when the Sonne were in that circle, the daye woulde be equall with the nyght: which thing as all nations confesse, happeneth at one tyme to all menne, and that is when the Sonne is in the beginning of Aries or Libra, precisely vnder the Equinoctiall lyne: wherefore not onlye that circle dooth ryghtly agree with hys name, but also it foloweth that the same Equinoctiall line is equallye parted into twoo iuste partes by the Horizont. And therefore the earthe muste needes bee iudged to bee in the centre of the worlde.

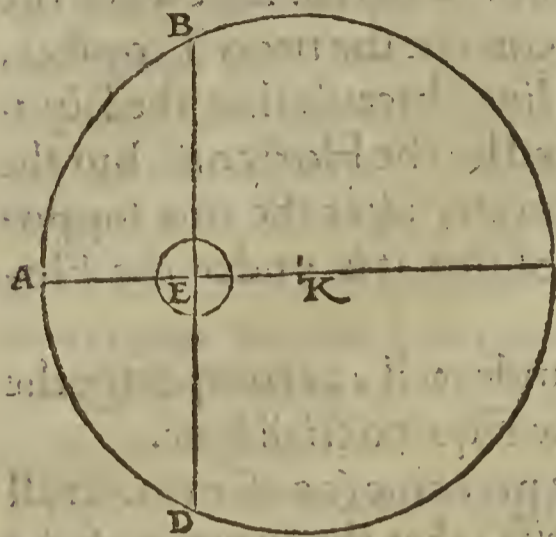
Farthermore, if the earthe were supposed to bee to-

O.ij.

warde

An other cō-  
futation of  
that firste  
opinion.

ward the easte or toward the weste, from the myddle of the world, (as in this figure it is set toward the easte, which is li-



imited by A) thē as the space toward the one side is shorter thē the space to the other side frō the earth, so the stars woulde seeme bigger in that nearer part, and lesser in that farther parte.

Sc. Which thing is before reproued; and by daily experience may be confuted.

Master. Therefore can not it be a true opinion, that inferreth so false a conclusion. And yet there woulde follow of it more absurditie: that from the morning vntill noone should bee shorter tyme, or els longer then from noone vntill nyght.

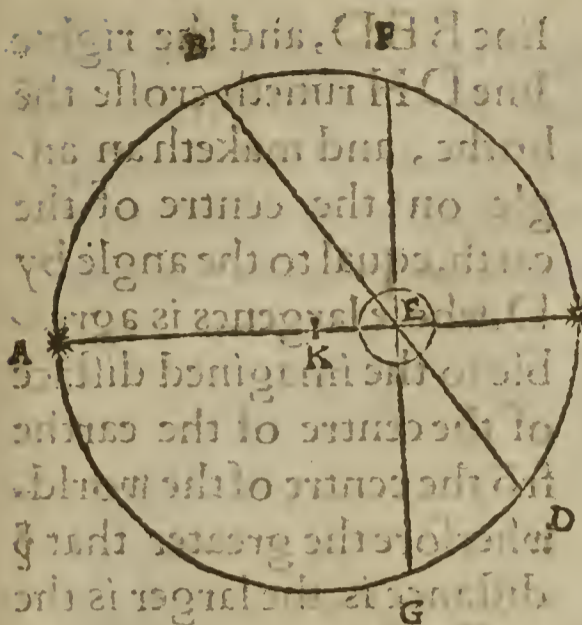
Scholar. That must needes folow also, seeing that noone is that time of the daye, when the sonne is in the circle which goeth right ouer our headdes from south to north, whiche here in this figure is represented by the right line B E D, as I gather by your former doctrine.

An abbrid-  
ged argu-  
ment of all  
the premi-  
ses.

Master. You gesse well. and by the contrarye of all these you may conclude thus: that seying the tyme before noone is equalle to the tyme after noone, and the starres appeare nother bygger nor lesser in the weste, then they doo in the easte: And that when the sonne is in the Equinoctiall lyne, the dayes are equall to the nightes, it foloweth certainlye, that the earthe canne bee no wayes out of the Axe tree of the worlde.

Against the  
second opi-  
nion.

And now for the seconde opinion I reason thus.  
If the earthe were on the Axe tree of the worlde nygher to the one Pole then to the other, then woulde the Horizonte onlye in the righte Sphere dyuide the skye into



twoo equall partes, and in no forme of bowing sphere, as by this figure you may gather, wher E standeth for the earth, and A E C for  $\bar{p}$  right horizon. B E D and F E G for two oblique horizontes, in 2 feuerall bowing sphers: and K limiteth the centre of the worlde.

Scholar. Here I see manifestly that only the right horizon dooth diuide the greater circle (whiche is sette for the skie) into 2 equall partes, and none other: wherby it would folowe, that wee whiche dwell 52 degrees northwarde from the Equinoctiall lyne, shoulde see muche lesse then halfe the skye: but that is false, as it hath beene often tymes proued, wherfore I perceaue that opinion can not be true.

Master. Yet an other argumente againste that opinion, may this be. If the earthe were nygher to the one Pole then to the other, when the Sonne is in the iuste easte, the shadowes of anye thinges in earthe, woulde not runne full weste: but all shaddowes in earthe runne full weste, when the Sonne is iuste easte: (and contrarye wayes) therefore canne not the earthe bee nygher to one Pole, then to the other.

Scholar. This argumente is good, and the minor is well knownen to euerye sensible man: so is there no doubt but of the maior.

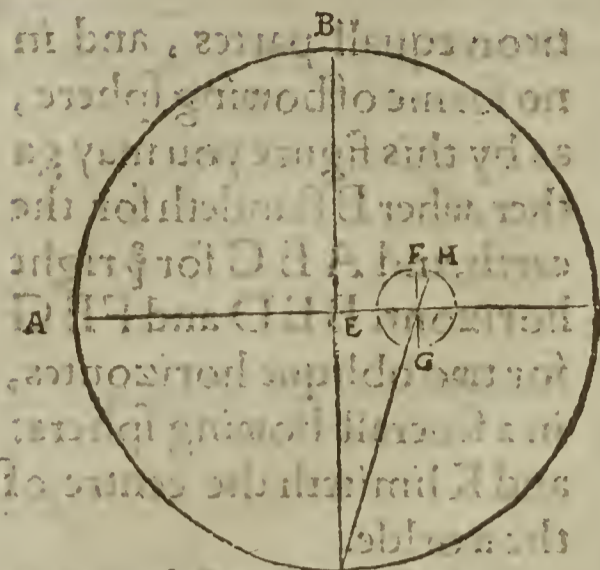
Master. For the prooffe of it, I sette this figure. Wher the great circle A B C D betokeneth the Horizon, and the lesser circle E F G H, standeth for the earthe. The centre of the worlde is E: the east is D: and the weste is B: the south is A: and the northe is C. In the earthe the lyne F G, standeth as a Parallele, wyth the ryghte

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An other  
argumente  
against the  
second opi-  
nion.

-100 100 100

-100 100 100



line B E D, and the righte line D H runeth crosse the bothe, and maketh an angle on the centre of the earth, equal to the angle by D: whose largenes is agreeable to the imagined distāce of the centre of the earthe frō the centre of the world. wherfore the greater that p distance is, the larger is the

angle of that declination, and the lesser distaunce, causeth a lesser angle: but yet if the distaunce be any thing, then will that angle of declination be notable inoughe.

Scholar. The reste is easye to confidre: I meane that all shaddowes runne in a right line from the lyght bodye, that causeth that shadow: so that the sonne being in D, which is the iuste easte, wolde cast the shaddowes in the earthe, not to F (which is the west in the earth) but to H, which is almoſte northwest: and therefore is your maior duely proued, and the seconde opinion fully confuted: but how may the thirde opinion be answered?

Against the  
thirde opi-  
nion.

A confir-  
mation.

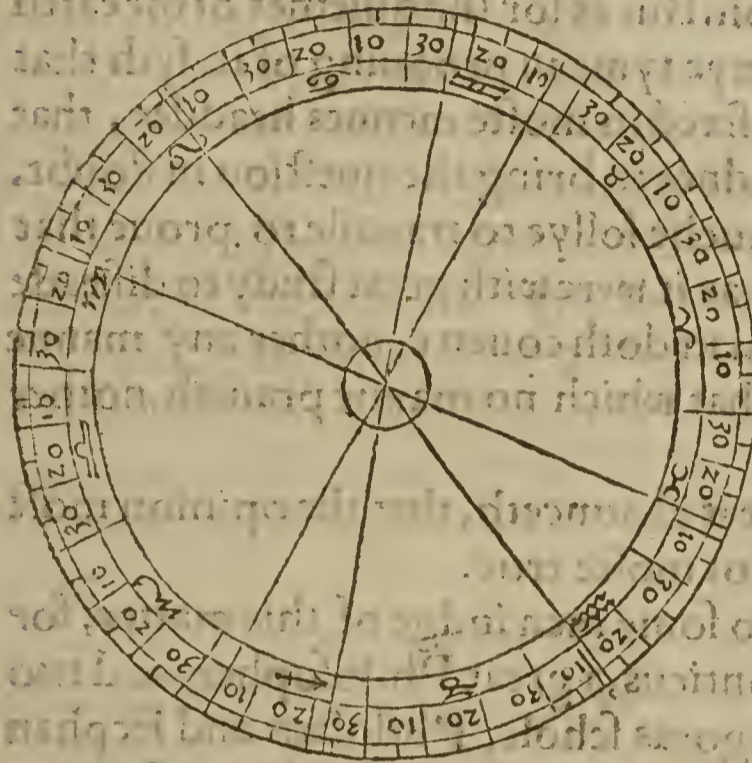
An other  
reason.

Master. The thirde opinion is, that the earthe standeth out of the axe tree of the worlde, and also nearer to the one pole then to the other: so doth it containe both the other opinions: wherfore seying they both are reprovēd, this third muste needes seeme falsse then ony of them bothe, bycause it includeth all the vntruthe of them bothe. And therefore to conclude with Ptolemye, the increase and decrease of dayes coulde neuer be so ratable and iustly proportioned as they be, if the earthe stode any where els, then in the very centre of the worlde. And farther more the eclipses of the moone shuld not happē, (as now they do) at the precise hour of ful opposition, if the earthe were not in the very centre of the worlde: for considering that all the thre bodies of the Son,

the

the moone, and the earthe muste needes be in one right line (as in the doctrine of those eclipses it is taught) there is no place in the worlde, where the earth may stand in that right line common to all suche eclipses, but only the centre of the worlde: as for examples sake I haue noted 4 seuerall eclipses

of the moone: the first was in 5 year of Christes incarnation 1551, the 20 day of Februarye, when the Sonne was aboute the 12 degree of Pisces, and the moone aboute the 12 degre of Virgo. The seconde eclipse was in the yeare of 1553, the sonne being in the eleuenth degree of Leo, and the moone in the



eleuenth degree of Aquarius: The thirde eclipse happened on the fiste daye of Iune, 1555, the sonne being in the 23 degre of Gemini, and the mone in the 23 of Sagittary. The fourth eclipse, shalbe this yeare 1556, the 17 daye of Nouembre, at whiche time the sonne shalbe in the fiste degre of Sagittary, and the moone in the fiste degree of Gemini. Nowe if you lyst to take more examples, for farther tryall you maye so doo. yet two seuerall eclipses serue as well for this prooffe as 10000. And then drawing lines for eche eclipse frō the place of the sonne to the place of the moone, all those lines muste needes passe by the earthe, and there is none other pointe, wherby they all (or any two of them) can passe, but onelye the centre of the Zodiak, (which is the centre of the world) therefore muste that centre of necessitie bee accompted the place of the earthe. And this may suffice for this time touching the earthe and his accidentes, principallie appertai-

O.iiij.

nyng

Whether  
the earthe  
moue or  
not.

ninge to Astronomie: for althoughe manye other thinges are to bee considered in it, they appertaine rather to philosophers or Cosmographers, then to Astronomers, and namely in the doctrine of the principles. As touching the distinction of the zones, I haue sayde somewhat before, & somewhat more wil I say anon. But as for the quietnes of the earth I neede not to spende anye tyme in proouing of it, syth that opinion is so firmlye fixed in moste mennes headdes, that they accōpt it mere madnes to bring the question in doubt. And therefore it is as muche follye to trauaile to proue that which no man denieth, as it were with great study to disuade that thinge, which no man doth couette, nother any manne alloweth: or to blame that which no manne praiseth, nother anye manne lyketh.

Schol. Yet sometime it chaunceth, that the opinion most generally receaued, is not moste true.

Master. And so doo some men iudge of this matter, for not only Eraclides Ponticus, a great Philosopher, and two great clerkes of Pythagoras schole, Philolaus and Ecphantus, were of the contrary opinion, but also Nicias Syracusius, and Aristarchus Samius, seeme with strong arguments to approue it: but the reasons are to difficulte for this firste Introduction, & therefore I wil omit them till an other time. And so will I do the reasons that Ptolemy, Theon & others doo alleage, to prooue the earthe to bee without motion: and the rather, bycause those reasons doo not proceede so demonstrablye, but they may be answered fully, of him that holdeth the contrarye. I meane, concerning circularre motion: marye direct motion out of the centre of the world, seemeth more easy to be confuted, and that by the same reasons, whiche were before alleaged for prouing the earthe to be in the middle and centre of the worlde.

Scholar. I perceauē it well: for as if the earthe were alwayes oute of the centre of the worlde, those former absurdities woulde at all tymes appeare: so if at anye tyme  
the

the earthe shoulde moue oute of his place, those inconueniences would then appeare.

Master. That is trulye to be gathered: howe bee it, Copernicus a man of greate learninge, of muche experience, and of wondrefull diligence in obseruation, hath renewed the opinion of Aristarchus Samius, and affirmeth that the earthe not only moueth circularlye about his owne centre, but also may be, yea and is, continually out of the precise centre of the world 39 hundreth thousand miles: but bicause the vnderstanding of that controuersy dependeth of profounder knowledg then in this Introduction may be vttered conueniently, I will let it passe tyll some other time.

Scholar. Nay syr in good faith, I desire not to heare such vaine phantasies, so farre againste common reason, and repugnante to the consente of all the learned multitude of Wryters, and therefore lette it passe for euer, and a daye longer.

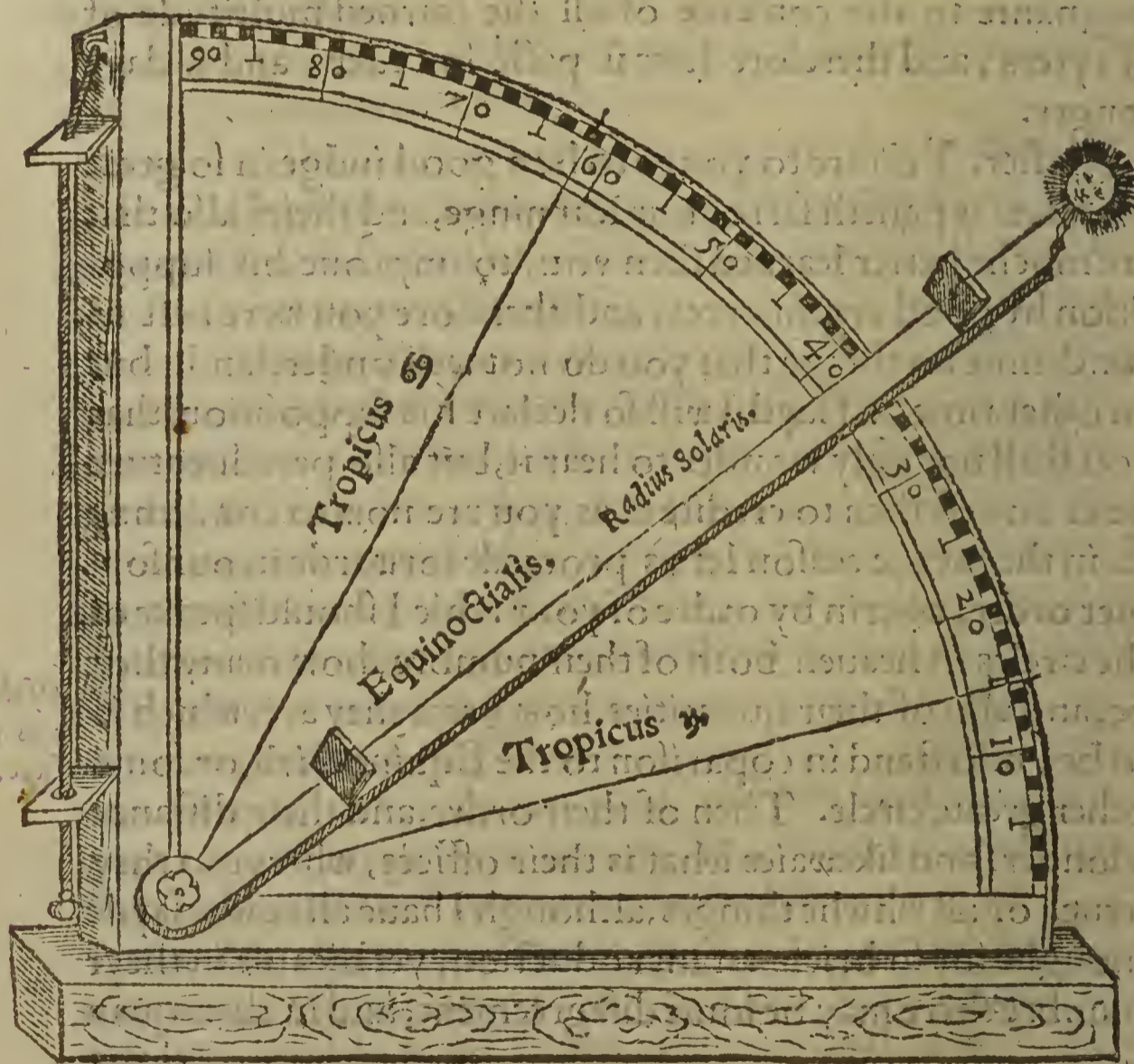
Master. You are to yonge to be a good iudge in so great a matter: it passeth farre your learninge, and theirs also that are muche better learned then you, to improue his supposition by good argumentes, and therefore you were best to condemne no thinge that you do not well vnderstand: but an other time, as I sayd, I will so declare his supposition, that you shall not only wonder to hear it, but also peradventure be as earnest then to credite it, as you are now to condemne it. in the meane ceason let vs proceede forward in our former ordre, wherein by ordre of your table I should speake of the circles in heauen, both of their numbere, how many they be, and also of their quantities, how great they are, which is to be vnderstand in cōparison to the Equinoctiall, or some other greate circle. Then of their ordre, and their distance a sonder: and likewaies what is their offices, whervnto they serue: of all whiche thinges, although I haue all ready sayde inoughe for so briefe an Introduction, yet bicause in theyr numbere there may be some disagreement, and in their quantities

Of the circles in the skye.

Equinoctial

the tropik

ties. distances and ordre there maye bee some varietie, at the leaste in diuers places, therefore I will speake a little of them againe. First for the equinoctiall, there is but one thorough all the world, and he is equally distaunt from eche Pole, and therefore is called the Girdle of the skye: hys office was declared beefore to bee the lymite of the myddle of the world, in whiche the Son maketh the dayes equall to the nyghtes. Also hee declareth the true east and west, and is not onely the common measure wherby all other circles are iudged in quantitie, but also it is the true measure of motions celestiall, and the very rule to iudge all ascensions by, as hereafter more largely shall appeare. Nexte vnto this circle are there 2 Tropike circles, one on eche side of it,



whose distaunce a sonder may well be marked by a quadrant set so in place conuenient, that it may stand iust plumbe with the flatte of the horizon, and be tourned full southe. Then obserue many daies aboute the middle of Iune the hyghest point that the sonne wyll ascend vnto, and shine duely thorough those two sightes in the ruler, mouinge it hygher or lower, as occasion serueth, tyll it stande exactly pointinge the heyghte of the Sonne at noone beyng at the highest. The lyke obseruation shall you make diuers dayes before, at and after the myddle of Decembre, tyll that you be assured of the iuste heighte at noone of the sonne, beyng at the lowest then toward the southe. The pointes of these two obseruations well marked in the edge of the quadrante, are the true places of the two Tropikes: and the distaunce of those two markes a sonder by numbres of degrees, is the very true distaunce of the two Tropikes. In the iuste myddle between these two tropikes is the place of the Equinoctiall circle. Example. With vs, where the pole is 52 degrees highe, the winter tropike wyll be 14 degrees and a halfe aboue the Horizon, the sommer tropike 61 and a halfe, and the Equinoctiall iuste 39 degrees in heighte. And the numbres of degrees that are betweene this Equinoctiall and any one of the tropiks is named the Greatest declination of the sonne, whiche in our time is about 23 degrees and 28 minutes. The other pointes of declination of the degrees in the ecliptike line from the equinoctial circle, bicause they be many in numbres and diuerse in vse, I thinke it good to expresse in a table which hereafter shall serue you for fundry vses.

Scholar. The like table is in Orontius.

Master. Not euen the lyke, as by conferring you maye perceaue: but for the vse of it, take what degree you list of anye Signe, and by this table you maye knowe his declination from the Equinoctiall circle. The Signes are written partelye on the headde of the table, and partelye on the foote of the same. The degrees in the fyrste  
columnne

*The gretest  
declination  
of the sonne*

THE FOVRTH TREATISE OF  
 THE TABLE OF DECLINATION  
 PARTICULARLY FOR EVERY DEGREE  
 of the Ecliptike lyne, and so for the Sonne.

	Aries, Libra,		Diffe- rence.	Taurus, Scorpius.		Diffe- rence.	Gemini, Sagittarius.		Diffe- rence.	
deg.	degr.	min.	min.	deg.	min.		degr.	min.		deg.
1	0	24	24	11	50	21	20	23	12	29
2	0	48		12	11		20	35		28
3	1	12		12	32	20	20	47	11	27
4	1	36		12	52		20	58		26
5	1	59		13	12		21	9		25
6	2	23		13	32		21	20		24
7	2	47		13	52	19	21	30	9	23
8	3	11		14	12		21	40		22
9	3	34		14	31		21	49		21
10	3	58		14	50		21	58		20
11	4	21		15	9	18	22	7	8	19
12	4	45		15	27		22	15		18
13	5	8	23	15	45		22	23	7	17
14	5	32		16	3		22	30		16
15	5	55		16	21	17	22	37	6	15
16	6	18		16	39		22	44		14
17	6	41		16	56		22	50	5	13
18	7	4		17	13		22	55		12
19	7	27	22	17	29	16	23	1	4	11
20	7	50		17	46		23	5		10
21	8	12		18	2		23	10		9
22	8	35		18	17		23	13		8
23	8	57		18	33	15	23	17	3	7
24	9	19		18	48		23	20		6
25	9	41		19	2		23	22		5
26	10	3		19	17		23	24		4
27	10	25	21	19	31		23	26	1	3
28	10	47		19	44		23	27		2
29	11	8		19	58		23	28	0	1
30	11	29		20	10		23	28		0
degr.	degr.	min.		degr.	min.		degr.	min.		deg.
	Virgo. Pisces.		Diffe- rence.	Leo. Aquarius.		Diffe- rence.	Cancer. Capricorn.		Diffe- rence.	

columnne

columnne doo serue for the signes that bee on the heade of the table, and the degrees in the laste columnne doo serue for the signes in the foote of the table, and the common angle against the signe: and the degree that you seeke for, doth containe the degrees and mynutes of the declination due to it.

Scholar. I perceauē it well: if I would knowe howe much the tenth degree of Leo doth decline from the equinoctiall, I must looke in the column ouer Leo right against the nūbre of tenne in the laste columnne, where I fynd 17. 46.

Master. That is 17 degrees, and 46 minutes, which is the declination of the 10. degree of Leo from the equinoctiall circle.

Scholar. I must alwaies vnderstande that 60 minutes do make a degree: so these 46 minutes are  $\frac{2}{3}$  of a degree and  $\frac{1}{6}$  more. But what is the vse of this table?

Master. That shall you knowe in the next treatise. in the meane ceason to procede with the parallele circles: there foloweth next, the Arctike and Antarctike circles, whiche are in numbre two, and there office is to enclose those starres, whiche euer appeare aboue our horizont, or neuer appeare aboue the same, as before is declared: but bycause euerye feueralle Climate hath those cyrcles disagreynge frome other Climates, therefore theyr distaunce frome the other cyrcles Paralleles canne not bee certaine, (but for one region certaine) nother yet theyr quantities, nother theyr ordre: for where the eleuation of the pole is lesse then 66 degrees and a halfe, there are those circles lesser then the tropikes, and are in ordre betwene them and the Poles, beinge alwaies distaunt from the Pole iust so many degrees as the Pole is in height aboue the Horizont in that region.

Scholar. It canne not bee other waies. And therefore it foloweth, that where the pole is more then 66 degrees and a halfe in height, there the Tropike is aboue the Horizonte, as at Wardehouse you declared it to be: and therefore

P.i.

in

The Arctike  
and Antar  
tik circles

in that climate the Arctik circle is greater then the Tropike of Cancer.

Of the five  
zones a-  
gainst the  
Greekes.

Master. Hereby appeareth the ouersight of moſte parte of the Greekes in limiting the Zones: for they appoint the Arctike and Antarctike circles for boundes of the Temperate Zones on the one ſide, and the Tropikes on the other ſide: wherof neither bounde can be well admitted, after their owne explication of the qualities of the Zones. for if the temperate Zones ſhall be called thoſe Zones that be inhabited, as they do ſo name them, then bycauſe there was known inhabited innumerable beſouthe the tropike of Cancer, it muſte needes followe, that the tropike canne be no bounde of the temperate Zone: but yet otherwaies accompliſhing the diſtinction of the Zones, not by that they are inhabited or vninhabited, but by the varietie of the motion of the ſonne in reſpect to them, and by other accidents of ſhaddowes, there maye be good reaſon to make the tropikes boundes of the temperate zones: mary there is not the like reaſon for the Arctike and Antarctike circles. for confutation therfore of that opinion, I make this argument.

An argu-  
ment in  
Ferio.

No vncertaine and variable boundes can limite anye certaine place: the temperate Zones are places certaine, and the Arctike circle with the Antarctike are chaungable, and vncertaine limites, Therefore can not they be the boundes of the temperate Zones.

Scholar. This is a good argument, made in Ferio, the ſwerth moode of the fyrſte figure. And the maior is moſte true, ſith nothing can more diſagree, then certain and vncertain, ſtable & vnſtable, being contraries together. The minor hath 2 partes in it, which both ſeeme as true: for as long as the Sonne keepeth one yearely courſe, ſo longe the regions muſte remaine as they were, and that is for euer, other ſtyll temperate, other ſtyll vntemperate. And ſo is that part of the minor true. The other part for the inſtancy & chaungablenes of the circles arctik & antarctik, muſt needes be true  
by

by their definitions, approued of the same Greekes: for euery region hath a feuerall Actike circle. Wherefore I meruaile muche that the Greekes beyng so wise men, and so greatly learned, shuld be so muche ouerseen and so foroly deceaued: but peraduenture ther are but few of that opinion, and such as were leaste learned.

Master. Parmenides, Aristotle, Cleomedes and Proclus may not be accompted vnlearned, and yet they with manye other haue written that as truth. But hereby may you perceauē what folly it is, whē men receauē any doctrine as true, and do not well weigh it, but credite the authority of the first teacher. So it appeareth in this matter, that bicause Parmenides, whiche was a great Philosopher, had fyrst taught that distinction of the zones, all the reste did folowe his opinion as a plausible doctrine, without examination of it, till Posidonius began to espye that errour & to confute it: as Strabo dothe declare in his second boke of Geographye, which place in the latine translation is so euell expressed, that no sentence in it importeth anye sence: wherefore as well for the commoditie of you as of other, I will sumwhat amend that place, wylshinge them that haue leasure and learning to help to amend many other faultes of that good booke and other lyke. The Latine translation is this.

Ad Septentriones, neq; penes omnes existentem, neq; eisdem vbi cunq;. Quis nā temperatas quæ immutabiles sunt diuideret? Cum igitur non penes vniuersos sit septentrionales esse, nihil esset ad argumentum. si enim penes habitatores temperatæ omnes, ad quos dicitur, solos temperatas. Quod autem non vbiq; eodem modo, sed mutari, bene comprehensum est. ipse autem in zonas partiens, quinq; ad cœlestia quidem vtilis esse asserit. Ex his duas circumstantes subter polos vsq; ad eas quæ septentrionales habent tropicos, diuersarum umbrarū esse ab alijs duabus, quæ deinceps sunt vsq; ad habitantes sub Polīs. Quæ vero inter Tropicos est, vtrinq; umbras habere.

A place of Strabo amended.

Scholar. Other the matter is very obscure, or els there wanteth lyghte in the declaration of it.

Ma. Ther is litle sence in all these words: & þ sence þ may be gathered of it is very false. And yet is þ greek boke both vn-

P.ij.

corrupt

corrupt (except it be in a worde or two) and full of perfect, sensible and pleasaunt sentences. this is it.

The prited  
booke hath  
οὕτω  
falsely.

τοῖς τε ἀρκτικαῖς, ὅτε παρὰ πᾶσι \* ὅσιν, ὅτε τοῖς αὐτοῖς πανταχοῦ πῶς ἀρ-  
δορίζοι πᾶσι ἐνκράτεος, ἀίπερ εἰσὶν ἀμετάπητοι. τὸ μὲν οὖν μὴ παρὰ πᾶ-  
σιν εἶναι τὸ ἀρκτικὸν, ὅδ' ἐν αὐτῷ ἐκ περὶ τοῦ ἐλεγχου. εἰ γὰρ παρὰ τοῖς τῆς  
ἐνκρατορ δίκῃσι \* εἶναι πᾶσι, περὶ ὅσων περὶ καὶ λέγεται μόνος ἐνκρατος, τὸ δὲ  
μὴ πανταχοῦ τὸν αὐτὸν τρόπον, ἀλλὰ μεταπίπτειν, καλῶς εἰληπται. αὐτὸς δὲ

The grecke  
booke hath  
περιόχου  
falsely.

ἡμεῖς εἰς τὰς ζώνας, πέντε μὲν φησὶν εἶναι χρῆστος πρὸς τὰ ὀράνια. τοῦτον  
δὲ \* περισκίσει δ' ὅτι τὰς ὑπὸ τοῖς πολλοῖς μέχρι τῶν ἐχόντων τοὺς τροπικοὺς ἀρ-  
κτικὸν, ἐπερὶ σκίσει δὲ τὰς ἐφεξῆς ταύταις δ' ὅτι μέχρι τῶν ὑπὸ τοῖς τροπικοῖς  
διόκωτον, ἀμφίσκιον δὲ τὸ μεταξὺ τῶν τροπικῶν.

Whiche I doo translate thus.

Arcticis verò circulis (vt qui nec apud omnes exsistant, nec ijdem vbiq; perseuerent) quib; vnquam temperatas Zonas (quæ immutabiles sunt) terminaret? Ceterum illud quod non apud omnes exsistant Arctici circuli, nihil facit ad reprehensionem. quum satis sit, si modo sint apud omnes incolas temperatæ ipsius zonæ, ad quos solos temperata dicitur. quod verò adiecit, non vbiq; seruare eos eandem rationem, sed varie mutari, hoc quidem rectè adsumptum est. Atq; ipse Posidonius dum Zonas destinguit, quinq; inquit vtilis esse ad cœlestes obseruationes. quarum duæ, quæ Polis subiacent, vmbas circumfluas habent, vnde Periscia dicuntur: ibiq; finiuntur vbi tropici ipsi pro arcticis circulis habentur. has sequuntur aliæ totidem, eò pertingentes, vbi Tropici verticibus incolarum imminet, atq; in his vmbæ meridianæ in vnam plagam porriguntur semper, hinc Heteroscia vocantur. quinta verò quæ inter tropicos iacet, in vtrunq; latus vicissim vmbas mittit, atq; Amphiscia nuncupatur.

Which words may be englished thus. What man (saith Posidonius) wold assigne the Arcticke circles to be as bounds to the temperate zones: seing those circles ar not in euery Climate: nother do they continue vniforme and of one sort to all cuntries. These wordes (saith Strabo) that they be not in euery climate, maketh nothing to the reproofe. for it is sufficient that they be incident to all the inhabitants of the temperate zone, in respect to whom alone that temperate zone beareth his name: but those other woordes, that they keepe  
not

not one vniforme manner in all places, but are diuersly changed: that is well alleaged. Also Posidonius him selfe when he distincteth the zones, doth say, that fīue zones are needefull and sufficient for celestiall obseruations: whereof two which be vnder the poles, are caled Periscia, or Round shadowed, bicause their shaddowes run round about them. And these zones extend to that place, where the tropik circles and the Arctike circles are all one. After these 2 there do follow two other, which reache from thence vnto those partes, that are directly vnder the tropiks: and these haue their noone shadowe running one waies styll, and therfore are called Heteroscia, or Single shadowed. The fift zone lyeth betwene the tropikes, and casteth the noone shadows 2 waies, wherefore the Greekes call it Amphiscion, that is Double shadowed.

Scholar. By this translation (which is worth a paraphrasis) I doo not onely perceauē the sence of these wordes, which before were darke, partly for the hardnes of the matter, and partly for the hypallage, in changinge of the speakers person, but also I espye the monstrous shape of the old translation. And by this I gather also, that Strabo woulde not haue the Temperat zones to be bounded by the Arctik and Antarctike circles.

Master. His mynde appeareth more manifest anon after where he blameth Polybius, for assigninge those circles as boundes of the zones: whereof one should be inclosed with in that circle, and the other should extend from it to the next tropike. then he concludeth thus: that those vnconstant circles, may be no boundes of certentye.

ἔστω γὰρ ὅτι τὸ μεταπίνουσι οὐ μέντοι οὐχ ὁρίσεται τὰ ἀμετάπιντα.

Dicitur enim est, quod per signa transinigrantia, ea quæ non mutantur, terminare non conuenit.

For I haue sayde before, that chaungable limites may not be appointed as boundes to vnchaungable places.

Sch. Thus it appeareth, that the distinction of zones by

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the

the Arctike and Antarctike circles were no constant distinction, and so is authority of one sorte repelled by thaucthoritie of an other sorte.

Master. You maye not weighe the matter by aucthoritye, for so shoulde that former doctrine continue styll, seynge I alleaged for it Parmenides, Aristotle, Polybius, Cleomedes and Proclus, & against them only Posidonius and Strabo, which maye seeme the weaker in numbre; but then conside that the firste sort bring only affirmation for their testimony, and bare authoritye: the other, confute theym by good reason and substantiall argumentes, whiche are farre to bee esteemed aboue anye authoritye.

Scholar. Then credityng reason against authority, I must say, that the Zones must be otherwaies diuided, peraduenture as I dyd learne of you before, agreable to Iohn de Sacrobosco his mynde, whom you called the restorer of the Zones.

Master. Yea in deede: for although Posidonius and Strabo did teache the like distinction, yet did they not so openly name the true limites, howe bee it in effecte they meane the same: for when Strabo saith, that the Cold zone doth reach to that place, where the Tropike is the Arctike circle, hee dooth meane that there, where this firste Zone endeth, and the temperate Zone beginneth, the Pole is 66 degrees and a halfe aboue the horizont, and so muste the same Pole bee from the toppe of their headdes in that place 23 degrees and a halfe: in whiche distaunce bicause the Poles of the Zodiacke do describe a circle, therefore doth Iohn de Sacrobosco call that circle the Arctike circle, in that confounding it in name with an other circle of the Greekes: wherfore I thinke it more reasonable for auoyding confusion, to gyue it a seuerall name, and call it the Polare circle, and the other to be called styll the Arctike circle, as the greeks longe before did name it. And this distinction of the zones by the two Tropikes, and the two Polare circles doth distinct exactly those

thre

The Polare  
circles.

three varieties of shadows before mentioned. which is a certaine and notable difference, not imagined by men which may erre, but wrought by the sonne, which can not erre. But heere muste I admonish you of an other erreure, gathered not of grounded reason, but of phantasticall imagination, by occasion of which, this sonde distinction of zones was imagined. An other erreure.

Bicause the elder Grekes had no trade into the south parts of Afrike, nother the Ethiopians again into Grece, and farther by reason the sonne runneth still ouer their headdes, that dwell betweene the tropikes, manye of the Latines as well as of the Grekes phantasied that there did dwell no inhabitantes, neither could dwell there for the vehement heat: wherfore they called it the Burned Zone. And of lyke occasion where they moued to accompt two other zones, that be nigh the poles, to be vninhabited for cold, by reason that the sonne doth neuer come nigher to them then the Tropik circles: but how muche herein they were deceaued, it maye be declared not only by reason, and by experience, but also by authority of many of their owne writers, as namely Eratosthenes, Posidonius, Polybius, and Ptolemye. but as this is a matter more agreeable to the treatise of Geographie or Cosmography, then of the Sphere, so will I ouerpasse it for this time, and will returne to the reste of the circles of the sphere, amongst which the Zodiake as principall, doth offer it selfe, as the common theatre and stage of all the planets motion, and of the chiefe signes and celestiall figures. The Zodi-  
ake.

Scholar. Are there I pray you suche figures in the Zodiake, as Astronomers do describe?

Master. There are some that affirme no lesse, and testifie that they haue in a cleere ayre perceaued them: but for the reste of the forme, I will say nothinge now: onely this I doo affirme which I know, that all the starres which astronomers do name to be there, maye easily be seene there, and in lyke forme as they doo place them.

P. iij.

Schol.

Scholar. If the formes of beasts be not there, why do they call it by that name of Zodiake, whiche name is deriued as many do affirme, of *ζῳδιον*, that signifieth a beaste.

Master. The Signes doo beare the names of beastes, and therefore may that circle take the like denomination also; but yet I denyed not that the verye formes were there, but that they are not easilye seene in suche exacte shape as they be portured, and as some men write that they haue seene them; but howe so euer it bee, the certenty is, that the 12 signes are contained in that zodiake, and therefore doth Tullye with other latine men call it Signifer, that is, the Circle of the Signes; but whye those names were giuen to euerye signe rather then other, dooth not appertaine so muche to this treatise, as to that Iudiciall arte, whiche hath more ground of reason then many men thinke.

What is to  
bee in a  
Signe.

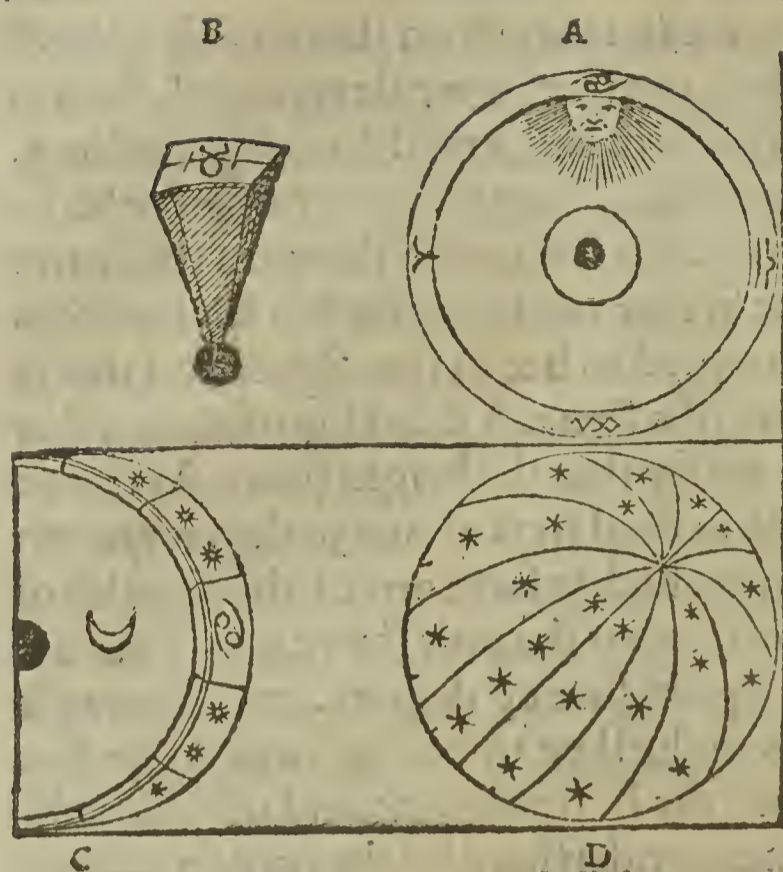
Scholar. When you saye that the Sonne is in anye signe, you do not meane (I am sure) that the Sonne hath lepte so high from his owne sphere, into the sphere of the Fixed starres, where the zodiake and the signes be, but that the Sonne is directly vnder the same signe, and in a righte line betwene that signe and the centre of the earthe.

The lati-  
tude of Pla-  
netes.  
Their decli-  
nation.  
Their lon-  
gitude.  
The second  
significatio  
of a signe.

Master. You saye well. That is the common vnderstandinge, when we speake of the place of the sonne; but bicause other Planettes doo decline from the myddle of that zodiake, some tymes towarde the north, and other times toward the southe, therefore haue all astronomers appointed a conuenient breadth to the zodiake, according to the declination of the Planets; howe bee it proprelye they doo call that the Latitude of the Planetes, when they swarue from the Ecliptike line; and the Declination of them is their distaunce southe or northe from the equinoctiall line: so doo they call the motion of them in Longitude, theyr distaunce by theyr naturall course frome the beginninge of Aries, which is the beginning of the zodiak. And now appointing the latitude of the zodiake to bee twelue degrees (although some

some planetes may runne in latitude on the one side almost 8 degrees) bycause that quantitie is moſte receaued, then is euerye ſigne twelue degrees broad, and thirtie degrees long. and ſo maketh a longe ſquare: frome the corners of whiche long ſquare, you may imagin lines to be drawẽ to the centre of the earth: and what ſo euer commeth within the boundes of thoſe lines, is accompted to bee in that ſigne: and this is the ſecond ſignification of a ſigne. A third ſignification ther is, which we uſe when we ſay that the bright ſtarre Arcturus is in Virgine, where as in deed he is aboue 30 degrees north from the Ecliptike line: which is farre out of the breadth of the Zodiake: and ſo we ſay that the pole ſtarre is in Taurus, whiche is from the Ecliptike line 66 degrees. and likewayes we name all the ſtarres in the ſkye to bee in ſome ſigne, bee they neuer ſo farre from the Ecliptike line, and the Zodiak. Therefore to know what is vnderſtand by the name of a ſigne in this ſignification, you muſt imagin 6 circles to be ſo drawen about the Globe, that they may paſſe by the beginning of all the ſignes (for euery circle will ſerue for two ſignes beinge contrarye one againſt the other) and ſo ſhall the whole Zodiake and all the globe alſo be parted into twelue equall partes, yf you haue drawen thoſe circles rightly & that they do paſſe al by the two poles of the Zodiak. Now mark how thoſe 2 lines that do incloſe any ſigne, ar wideſt a ſonder in myddle of the Zodiake, and from thence toward eche pole of the zodiake they come nearer and nearer, tyll they touch in the Pole it ſelfe. All the ſpace betweene anye two ſuche ſemicircles from one Pole to the other, is named a ſign in the thyrde ſignification: ſo that what ſo euer ſtarres bee within that ſpace, are named to bee in that ſigne which is within the ſame ſpace: of all theſe three diuers formes of ſignes heere maye you ſee examples. of the fyrſte by A, where the Sonne ſtandeth vnder the ſigne of Cancer. of the ſeconde forme you haue an example by B, and of the thirde ſorte you haue twoo varieties, one by C and an other by D. So that what  
ſo

*The thyrde  
ſignificatiõ  
of a ſigne.  
Arcturus.  
The Pole  
ſtarre.*



The colures.

so euer Planet doth come within  $\S$  boundes of that figure B, is named to be in the signe of Taurus : & what so euer Planete or fixed star is within the compas of the figure C, is iudged to be in Cancer : as  $\S$  Moone is ther represented to be and all the starres there portured, & so maye you iudge of anye other signe. Nowe

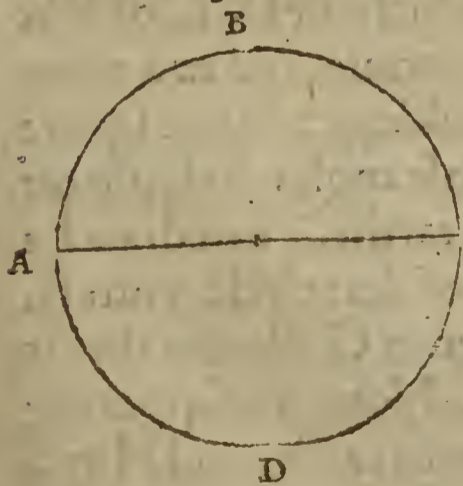
this maye suffice for the explication of the zodiacke, after whom foloweth nexte the Colures, whiche take their names in Greeke of vnperfectnes, bycause they bee neuer seene all aboute the grounde in any oblique sphere: whereby it appeareth, that good Iohn de sacro bosco was much deceaued in comparing them to the compassed bowing of a wild bulles taylor, as though they tooke their names thereof: but men must bear with the ignorance of that time, for lack of knowledge in the Greeke tongue. These Colures serue principally for the distinction of the four chiefe pointes in the zodiacke, as before is declared. and bycause the pointe of the intersection or crossinge of the ecliptike line and the equinoctiall, doothe sufficiently expresse two of those pointes in the beginning of Aries and Libra, therefore the greekes do assigne comonly but one Colure, for the other two tropike pointes, and none for these equinoctiall pointes. How be it, bycause they serue also for the declinations and latitudes of fixed starres and Planetes, I thinke it better to describe them, then to omitte them. And thus haue I lyghtly touched all the circles

cles that be fixed in the sphere, and moue with it. Nowe remaineth other two, which stand styll alwaies and moue not, of whiche the fyrste is the Horizonte, and the nexte is the Meridiane. The horizon is of twoo diuers sortes, the one doth extend on euery syde vnto the firmament, and serueth as it were peculiarly for the partition of the heauens, and diuideth the skie iustly into two halues, wherof the one appeareth vnto vs aboue that Horizonte, and the other is hidde from vs, vnder the same horizon: this horizonte hath his name of the skie, and is called the Celestial horizon, and his diameter is as large as the diameter of the eight spheer, which is the farthest and highest part of the skye that we canne see: this large horizon our sight doth inforce vs to acknowledg as a iuste horizon, although reason canne fynde in it some wante of exacte precisenes. And therfore Proclus doth not well distincte this horizon from the other, by naminge the other a sensible horizon, and affirming this to be considered only by reason, where as in deede we neede reasons helpe more in iudging the other horizon, whiche I thinke moste aptlye to bee called the Earthly horizon, bycause it serueth for sightes on the earthe and water onlye, and reacheth not vnto the skie: no, his semidiameter exceedeth not (as Macrobius saith) 180 furlongs, that is 22 myles and a halfe: and his whole diameter cōprehendeth but only 45 myles in length. So that if any man do stande on a plaine ground or on the sea, he maye see rounde about him euery waies 22 myles and

The Horizonte.

The celestial horizon

The Earthly horizon



a halfe: that is in round compas of the whole horizonte 141 miles  $\frac{2}{3}$ .

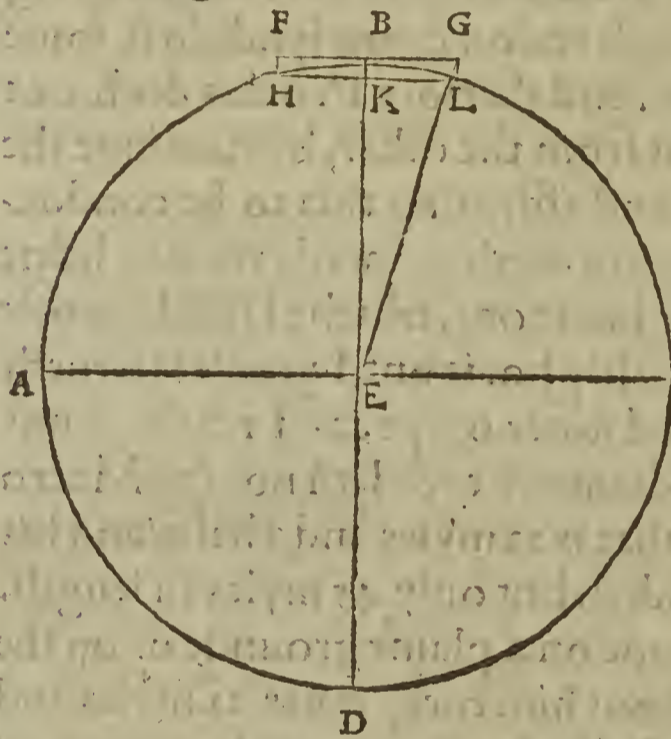
I meane that seing the right line A, C, is 45 miles, the whole circle A B C D, must bee accompted 141  $\frac{2}{3}$  myles in compas. This saynge of Macrobius is more nygher to the truth then Proclus assertion, which is that the diameter shuld be in this

hori-

horizont, 2000 furlonges, that is 250 myles, wherby he meaneth that a manne may see euery waye in a playne 125 myles from him: whiche assertion euery maryner dooth knowe to be false: for it is well knowne by often and good obseruation, that in plaine ground, or on the sea, they can not discern well aboue 20 myles, and therefore do all mariners call that

*A kenning.* distaunce commonly a Kenninge: whiche is as muche as a manne maye well see: yet from a hill or highe grounde men maye see farther, and especially they maye see other hilles or clyffes, but that is no certaine vewe, nor iuste kenninge: yet in that sort men may see 60 miles, or at the moste 80 miles: but 125 myles is to greate a distaunce, for to vewe any thing from a high place, and therefore of more force it is to excel-

*A demonstration against proclus.*



lue a distaunce to vewe any thinge in an equall plaine, as the horizont must needes be, for declaration wherof, I suppose this figure to represent the whole globe of the earthe, and the earthly horizont to be expressed by the ryghte lyne F B G: vnto which line ther is an other drawn as a iuste parallele, which is H K L. of lyke lengthe precisely with the earthly horizont, and two other lines ioyninge them at the eandes, makinge a longe square of all righte angles, so that two of those angles do lyght on the circumference of the circle of the earthe. Then draw I a right line from E which is the centre of that circle, vnto B, and an other from the same centre E vnto G: wherby ther is made two triangles E B G, and E K L. Nowe presupposing that B is the place where we stande on the earth, and H and L, the

vnto whiche the Semidiameter of 1000 furlonges of oure earthlye Horizont, dothe extende on bothe sides: and frome the one of them is drawen a right line to the other, that line must needes fall within the circle.

Scholar. That is true, accordinge to the 47 Theoreme of the Pathwaye.

Master. Then muste the line  $KE$ , be shorter then the lyne  $BE$ , and so  $B$  and  $K$ , are notably distaunte.

Scholar. That is certaine.

Master. And bicause the righte line  $FBG$ , is parallele to the righte line  $HKL$ , there must be as muche distaunce betweene  $G$ , and  $L$ , as there is betweene  $B$  and  $K$ .

Scholar. That foloweth by the definition of Paralleles.

Master. Then as  $K$ , is notably vnder  $B$ , so must  $L$  be notably vnder  $G$ : that is to say vnder the Horizont, and therefore can not be seene.

Scholar. It is against the definition of an horizont, that anye thinge vnder it shoulde be seene.

Master. Then if the semidiameter of the Horizonte shall extend no farther then that a meane quantitie maye be seene on the earth, it maye not be so longe as Proclus hath limited it. Also by the two triangles aforesaide, whole angles are like, and therefore their sides proportionable, & other waies diuersly, by the former figure, it may be demonstrate, that the righte line  $EG$  is muche longer then  $EL$ , whiche is the semidiameter of the earthe, so that the horizont in so much distaunce is farre hygher then the earth is there, and therefore canne not bee aptelye called a Sensible Horizonte, nor an Earthly Horizonte, as Proclus meaneth. But it appeareth that Proclus dydde rather in this doctrine followe some other mennes opinion then hys owne reason, as he dooth also in the declaration of the chaunge of the Horizontes and the Meridianes, for betweene east and weste, hee saythe that the Meridianes chaunge at the eande of 300 furlonges: but betweene southe and northe hee dooth as-

Q.i.

signe

signe no chaung vnto the Horizonts within 400 furlongs. In whiche woordes there are two errours included: the one that the horizonts be not like in chaunge betwene easte and weste, and betwene southe and northe.

Scholar. Nay he speaketh only of the Meridianes (I trow) betwene easte and west, and not of the Horizontes.

Master. As though we might chaunge the one, and not vniformely chaunge the other.

Scholar. Truthe it is, that seing the meridiane doth cutte the Horizont e with right angles, they both must needes other stand bothe still, other chaunge bothe a like: wherefore this firste erreure can not be excused.

Master. And the seconde errour is as manifest as it: for therby he supposeth that the Climates do chaunge by equal quantity of furlonges or miles, which errour is to manifest: for nighe vnto the equinoctiall, 2150 furlonges northwarde do cause increase but of a quarter of an hower in the longest daye. And with vs in the southe parte of England, 700 furlonges northwarde dooth cause increase of a quarter of an hower in the longest daye, and in the north partes of Scotlande, 320 furlonges doo giue as great an increase: in Iselande 4 furlonges yeldeth the lyke increase: and so styll the farther northe you go, the smaller space of ground bringeth the like increase in the longest daye.

Scholar. Hereby I perceauē, that who so euer will trauaile in these sciences with profit, must lean rather to reason, then to authoritie, els he may be deceaued.

Master. That rule is generall in all artes.

Scholar. And if Proclus rule be not certen, what rule may I haue more certen? M. For the alteratiō of the Horizonte betwene south & north, bicause not only the climats do chāg therwith, but also the quantities of y<sup>e</sup> daies, I wil anon before the doctrine of the ascensions, giue you a table generall for all climates in the earthe. And as for the chaunge of the horizontes or of the meridianes betwene easte and weste, you

Chall

A TABLE FOR THE DIFFERENCE OF HOURS ACCORDING TO THE DISTANCE OF MILES FROM EAST TO WEST, UNDER THE EQUINOCTIAL.

The distance of miles.	The minutes of an hour.	The distance of miles.	Hours.	The minutes of an hour.	The distance of miles.	Hours.	The minutes of an hour.	The distance of miles.	Hours.	The minutes of an hour.
15	1	465	0	31	915	1	1	1365	1	31
30	2	480	0	32	930	1	2	1380	1	32
45	3	495	0	33	945	1	3	1395	1	33
60	4	510	0	34	960	1	4	1410	1	34
75	5	525	0	35	975	1	5	1425	1	35
90	6	540	0	36	990	1	6	1440	1	36
105	7	555	0	37	1005	1	7	1455	1	37
120	8	570	0	38	1020	1	8	1470	1	38
135	9	585	0	39	1035	1	9	1485	1	39
150	10	600	0	40	1050	1	10	1500	1	40
165	11	615	0	41	1065	1	11	1515	1	41
180	12	630	0	42	1080	1	12	1530	1	42
195	13	645	0	43	1095	1	13	1545	1	43
210	14	660	0	44	1110	1	14	1560	1	44
225	15	675	0	45	1125	1	15	1575	1	45
240	16	690	0	46	1140	1	16	1590	1	46
255	17	705	0	47	1155	1	17	1605	1	47
270	18	720	0	48	1170	1	18	1620	1	48
285	19	735	0	49	1185	1	19	1635	1	49
300	20	750	0	50	1200	1	20	1650	1	50
315	21	765	0	51	1215	1	21	1665	1	51
330	22	780	0	52	1230	1	22	1680	1	52
345	23	795	0	53	1245	1	23	1695	1	53
360	24	810	0	54	1260	1	24	1710	1	54
375	25	825	0	55	1275	1	25	1725	1	55
390	26	840	0	56	1290	1	26	1740	1	56
405	27	855	0	57	1305	1	27	1755	1	57
420	28	870	0	58	1320	1	28	1770	1	58
435	29	885	0	59	1335	1	29	1785	1	59
450	30	900	1	0	1350	1	30	1800	2	0

shall vnderstande that 15 myles difference from east toward west, doth make the sonne risinge, the none steed, and Sonne setting, to be later by one minut of an houre. and so 30 miles 2 mynutes: 120 myles 8 minutes: 225 myles, 15 minutes. which is a quarter of an hower. And for exammples sake more then for any other cause I giue you here this table, which you may easlye increase by the lyke fourme, vntyll you haue accomplyshed the whole 24 howers, yf you lyst. howe bee it hee that is readye in accompte of Arithmetike, needeth not anye suche tables of ayde. This table is calculate onlye for suche places as dyffer not aboue 1300 myles betweene east and weste, hauynge no difference or verye lytle in their distaunces betweene southe and north, as touching this consideration. And it serueth onlye for the middle climate of the worlde vnder the equinoctiall circle. for euerye other climate, yea and euerye degree in latitude of eche climate, must haue a seuerall table, whiche maye not well be set forth in this brief introductiō, but an other time shall serue hereafter for it, yf you call on me and put me in mynde thereof, els the necessite of prouision for my familie will make me forget suche promises; howe be it bycause you shall not thinke that I haue done more for them that dwell vnder the equinoctiall (or nygh vnto it in Guynea or in Calecut) then for our own cuntrie, I haue drawen the like table for the eleuation of 52 degrees, whose vse is euen one with the other before. wherefore if I knowe the distaunce of myles betweene anye twoo places vnder this latitude of 52 degrees, or nyghe thereto, as soone as I haue founde out that numbere of myles in the table vnder that title, in the nexte columpne on the righte hande, I maye see howe manye minutes they do differ in theyr howers.

Scholar. So that the miles exceede not 1110, for this table hathe no greater numbere.

Master. If you lyst by this president, you may increase the table as muche as you myll.

Scho-

## A TABLE OF THE DIFFERENCE

of howers, according to the distaunce of miles  
from east to west, for the eleuation of 51  
degrees, 55 minutes.

The distance of miles.	The minutes of an hower.	The distance of myles.	The howers.	The minutes of an hower.	The distance of myles.	The howers.	The minutes of an hower.	The distance of myles.	The howers.	The minutes of an hower.
9 $\frac{1}{4}$	1	286 $\frac{1}{4}$	0	31	564 $\frac{1}{4}$	1	1	841 $\frac{3}{4}$	1	31
18 $\frac{1}{2}$	2	296	0	32	573 $\frac{1}{2}$	1	2	851	1	32
27 $\frac{3}{4}$	3	305 $\frac{1}{4}$	0	33	582 $\frac{3}{4}$	1	3	860 $\frac{1}{4}$	1	33
37	4	314 $\frac{1}{2}$	0	34	592	1	4	869 $\frac{1}{2}$	1	34
46 $\frac{1}{4}$	5	323 $\frac{3}{4}$	0	35	601 $\frac{1}{4}$	1	5	878 $\frac{3}{4}$	1	35
55 $\frac{1}{2}$	6	333	0	36	610 $\frac{1}{2}$	1	6	888	1	36
64 $\frac{3}{4}$	7	342 $\frac{1}{2}$	0	37	619 $\frac{3}{4}$	1	7	897 $\frac{1}{4}$	1	37
74	8	351 $\frac{1}{2}$	0	38	629	1	8	906 $\frac{1}{2}$	1	38
83 $\frac{1}{4}$	9	360 $\frac{3}{4}$	0	39	638 $\frac{1}{4}$	1	9	915 $\frac{3}{4}$	1	39
92 $\frac{1}{2}$	10	370	0	40	647 $\frac{1}{2}$	1	10	925	1	40
101 $\frac{3}{4}$	11	379 $\frac{1}{4}$	0	41	656 $\frac{3}{4}$	1	11	934 $\frac{1}{4}$	1	41
111	12	388 $\frac{1}{2}$	0	42	666	1	12	943 $\frac{1}{2}$	1	42
120 $\frac{1}{4}$	13	397 $\frac{3}{4}$	0	43	675 $\frac{1}{4}$	1	13	952 $\frac{3}{4}$	1	43
129 $\frac{1}{2}$	14	407	0	44	684 $\frac{1}{2}$	1	14	962	1	44
138 $\frac{3}{4}$	15	416 $\frac{1}{4}$	0	45	693 $\frac{3}{4}$	1	15	971 $\frac{1}{4}$	1	45
148	16	425 $\frac{1}{2}$	0	46	703	1	16	980 $\frac{1}{2}$	1	46
157 $\frac{1}{4}$	17	434 $\frac{3}{4}$	0	47	712 $\frac{1}{4}$	1	17	989 $\frac{3}{4}$	1	47
166 $\frac{1}{2}$	18	444	0	48	721 $\frac{1}{2}$	1	18	999	1	48
175 $\frac{3}{4}$	19	453 $\frac{1}{4}$	0	49	730 $\frac{3}{4}$	1	19	1008 $\frac{1}{4}$	1	49
185	20	462 $\frac{1}{2}$	0	50	740	1	20	1017 $\frac{1}{2}$	1	50
194 $\frac{1}{4}$	21	471 $\frac{3}{4}$	0	51	749 $\frac{1}{4}$	1	21	1026 $\frac{3}{4}$	1	51
203 $\frac{1}{2}$	22	481	0	52	758 $\frac{1}{2}$	1	22	1036	1	52
212 $\frac{3}{4}$	23	490 $\frac{1}{4}$	0	53	767 $\frac{3}{4}$	1	23	1045 $\frac{1}{4}$	1	53
222	24	499 $\frac{1}{2}$	0	54	777	1	24	1054 $\frac{1}{2}$	1	54
231 $\frac{1}{4}$	25	508 $\frac{3}{4}$	0	55	786 $\frac{1}{4}$	1	25	1063 $\frac{3}{4}$	1	55
240 $\frac{1}{2}$	26	518	0	56	795 $\frac{1}{2}$	1	26	1073	1	56
249 $\frac{3}{4}$	27	527 $\frac{1}{4}$	0	57	804 $\frac{3}{4}$	1	27	1082 $\frac{1}{4}$	1	57
259	28	536 $\frac{1}{2}$	0	58	814	1	28	1091 $\frac{1}{2}$	1	58
268 $\frac{1}{4}$	29	545 $\frac{3}{4}$	0	59	823 $\frac{1}{4}$	1	29	1100 $\frac{3}{4}$	1	59
277 $\frac{1}{2}$	30	555	1	0	832 $\frac{1}{2}$	1	30	1110	2	0

Scholar. Bicause examples do make rules manifest, I pray you let me proue one example. London and Bristow are 94 myles a sonder, and as I haue hearde you saye, they are not muche different in latitude: I desire to know their difference in howers, therfore I seeke for 94 vnder the title of distaunce of myles, and I can not find it there, for 92 and a halfe is to lyttle, and  $101\frac{1}{4}$  is to greate.

Master. And in lyke rate is there difference of minutes: for 10 minutes is to lytle, and 11 minutes is to greate. but to gesse moste nearest: as 92 and a halfe is nigher to 94 then  $101\frac{1}{4}$ : so is 10 minutes more nearer their true difference then 11. And for this time this maye suffise, althoughe I can giue you a precise rule by the part proportionable to fynde oute the iuste parte of euery minute, but that were more curious then profitable in this place: Therfore will I leaue it, and declare vnto you, how you may make the lyke table for any latitude of euen degrees.

Scholar. I do perceauue by these two tables, that if I haue ones the fyrst numbres which must be set against one minute of tyme, then must I double it for two minutes, and triple it for thre minutes, and so forth, styll multiplying the fyrste numbres of myles by the numbres of minutes against which it shall stende.

Master. You take it well, and therfore seyng you doubt only of the fyrst numbres, I will giue you a table by whiche you may easily find out that fyrste numbres for all degrees of latitude of any region. And this is it. where in the first colunne you see placed the degrees of latitude, and in the seconde colunne are set the myles with their fractions, which serue for one degree of longitude, in eche of those dyuers latitudes. By this table may you make any table for any eleuation of hole degrees, accordinge to the example of the former two tables.

Scholar. That do I perceauue nowe very well, and can do it, I doubt not, sufficiently for anye Climate, yf I were as  
certain

## A TABLE DECLARINGE

how many myles do answer to one minute of  
tyme, in euery feuerall latitude.

Degrees of latitude.	Miles agreig to i. minute of tyme.	Degrees of latitude.	Miles agreig to i. minut of tyme.	Degrees of latitude.	Miles agreig to i. minut of tyme.
0	15				
1	14 $\frac{230}{240}$	31	12 $\frac{103}{120}$	61	7 $\frac{13}{48}$
2	14 $\frac{79}{80}$	32	12 $\frac{173}{240}$	62	7 $\frac{1}{24}$
3	14 $\frac{43}{48}$	33	12 $\frac{139}{240}$	63	6 $\frac{97}{120}$
4	14 $\frac{77}{80}$	34	12 $\frac{21}{48}$	64	6 $\frac{69}{120}$
5	14 $\frac{113}{120}$	35	12 $\frac{69}{240}$	65	6 $\frac{81}{240}$
6	14 $\frac{11}{12}$	36	12 $\frac{2}{12}$	66	6 $\frac{1}{10}$
7	14 $\frac{71}{80}$	37	11 $\frac{47}{48}$	67	5 $\frac{207}{240}$
8	14 $\frac{41}{48}$	38	11 $\frac{197}{240}$	68	5 $\frac{149}{240}$
9	14 $\frac{40}{60}$	39	11 $\frac{79}{120}$	69	5 $\frac{2}{8}$
10	14 $\frac{37}{80}$	40	11 $\frac{59}{120}$	70	5 $\frac{31}{240}$
11	14 $\frac{87}{120}$	41	11 $\frac{77}{240}$	71	4 $\frac{53}{60}$
12	14 $\frac{161}{240}$	42	11 $\frac{7}{48}$	72	4 $\frac{19}{30}$
13	14 $\frac{37}{60}$	43	10 $\frac{231}{240}$	73	4 $\frac{21}{80}$
14	14 $\frac{132}{240}$	44	10 $\frac{19}{24}$	74	4 $\frac{2}{12}$
15	14 $\frac{117}{240}$	45	10 $\frac{73}{120}$	75	3 $\frac{53}{60}$
16	14 $\frac{101}{240}$	46	10 $\frac{101}{240}$	76	3 $\frac{141}{240}$
17	14 $\frac{82}{240}$	47	10 $\frac{11}{48}$	77	3 $\frac{2}{8}$
18	14 $\frac{4}{15}$	48	10 $\frac{9}{240}$	78	3 $\frac{7}{60}$
19	14 $\frac{11}{60}$	49	9 $\frac{101}{120}$	79	2 $\frac{207}{240}$
20	14 $\frac{23}{240}$	50	9 $\frac{77}{120}$	80	2 $\frac{29}{60}$
21	14 $\frac{1}{240}$	51	9 $\frac{53}{120}$	81	2 $\frac{83}{240}$
22	13 $\frac{109}{120}$	52	9 $\frac{7}{30}$	82	2 $\frac{7}{80}$
23	13 $\frac{97}{120}$	53	9 $\frac{1}{240}$	83	1 $\frac{109}{240}$
24	13 $\frac{169}{240}$	54	8 $\frac{49}{60}$	84	1 $\frac{17}{30}$
25	13 $\frac{143}{240}$	55	8 $\frac{29}{48}$	85	1 $\frac{37}{120}$
26	13 $\frac{29}{60}$	56	8 $\frac{93}{240}$	86	1 $\frac{11}{240}$
27	13 $\frac{11}{30}$	57	8 $\frac{41}{240}$	87	$\frac{47}{240}$
28	13 $\frac{59}{240}$	58	7 $\frac{19}{20}$	88	$\frac{21}{40}$
29	13 $\frac{29}{240}$	59	7 $\frac{87}{120}$	89	$\frac{21}{80}$
30	12 $\frac{119}{120}$	60	7 $\frac{1}{12}$	90	0

Of the cli-  
mates.

certaine of their boundes . but that maye I learne by suche tables as Orontius and dyuers other haue sette forth all readye.

The famous  
adventure  
vnto Mos-  
couia by  
the northe  
Ocean.

Master. In deede bothe Orontius and other haue set forth suche tables , whiche maye suffice for an Introduction, but Orontius extendeth not his table aboue the latitude of 66. degrees and a halfe, so there resteth vnto the northe Pole 23 degrees and a halfe, whiche coaste hytherto hath been known to very fewe men, but nowe of late by the famous adventure of that woorthye companye of our Englishe marchauntes for Moscouia, that coast is discovered vnto 75 degrees of latitude nighe hande: and our hope is that if they doo continue as they haue valiantlye begonne, they shall disclose those vnknown people whiche dwell directlye vnder the Pole, or at the leaste waies discover that climate, suche as it is, to the full satisfaction of that importune desire, whiche hath forced manye thousandes to wissh, that whiche not one yet (that we knowe) coulde attayne: whereby they shall not onelye profite their countrie, but shall procure to them selues greate ryches and treasure: and that whiche is moste to bee desired, immortall fame. Wherefore for my parte to further their knoweledge in the atchiuinge of their woorthye attempte, as I haue all readye in this booke giuen some lighte, so wyll I (God wyllinge) hereafter gyue more lighte: and for an earnest thercof I will nowe exhibyte to you a table of the Climates extended to the verie Pole, whereby you maye learne not onelye the beginninge and eande of euerye climate, but also the iuste quantitie of the longest and shorteste daye in eche of them, and in all other places to the Pole selfe: the reason whereof you shall better vnderstande by the diuersities of the ascensions. But bicause (as I saide beefore) that euerye Climate differeth frome other, by the space of halfe an hower in the quantitie of their longest daye, therefore did the greekes  
and

and namely Ptolemye, for a more precisenes make a certain distinction for euery quarter of an howers difference, whiche he calleth only by the generall names of paralleles, as it doth at large appear in the sixte chapter of the second booke of his *Almagestes*, wherof at anye other tyme I will more largelye intreate. And for this present time will onely sette forth the summe of that matter in a table, whose firste columpne doth containe the numbre of the paralleles as Ptolemye did distincte them. The seconde columpne contayneth a more exacte partition of those paralleles accordinge vnto the increase of the longest daye, by a quarter of an hower, whiche Ptolemye obserued not, after hee came to is howers of lengthe: but I obserue styll, vntill 24 howers of length, after which time and place, bicause the increase of the longest daye is greater and greater continuallye, I thinke it not good to make so curious a table for euery quarter of an hower, but (as Erasmus Reynhold doth) to make the distinction thence forth by halfe a degree of difference in eleuation of the Pole, as by the table you maye see.

In this table are sette forth the 96 paralleles iustlye: and but 38 by Ptolomies partition: the cause whereof, I will shewe you an other time. Of these paralleles are made 24 Climats betweene the Equinoctiall circle & the Tropike of Cancer. eche differinge frome other by halfe an hower, as the laste columpne of the table declareth. but the elder Greekes dyd not knowe verry well those North cuntries, and therefore did they assigne only 7 climats according as I haue set them annexed to the firste colunne of this table.

## A TABLE FOR THE IVSTE

distinction of Climates,

The numbre of the 7 climates according to the ol. de Greekes.	Parallels after Ptol		Parallels more exact		Elevation of the Pole.		The quantitie of the longest daye.		The Climates.	Parallels after Ptol.		Parallels more exact		Elevation of the Pole.		The quantitie of the longest daye.		The Climates.
	1	2	De.	Mi.	H.	M.	The names	De.		Mi.	H.	Mi.						
1	1	1	0	0	12	0	of the 7 climates after	25	25	58	27	18	0	13				
	2	2	4	18	12	15		26	59	15	18	15						
	3	3	8	34	12	30		2	some chiefe place in the.	26	27	59	59		18	30	14	
	4	4	12	43	12	45				28	60	40	18		45			
2	5	5	16	44	13	0	3	by Meroe	27	29	61	18	19	0	15			
	6	6	20	34	13	15			30	61	53	19	15					
3	7	7	24	11	13	30	4	by Siene.	28	31	62	25	19	30	16			
	8	8	27	36	13	45			32	62	55	19	45					
4	9	9	30	48	14	0	5	by Alex- andria.	29	33	63	22	20	0	17			
	10	10	33	46	14	15			34	63	47	20	15					
5	11	11	36	30	14	30	6	by the Rodes.	35	64	10	20	30	18				
	12	12	39	3	14	45			36	64	31	20	45					
6	13	13	41	23	15	0	7	by Rome	30	37	64	49	21	0	19			
	14	14	43	32	15	15			38	65	6	21	15					
7	15	15	45	31	15	30	8	by Ponte Euxine.	39	65	22	21	30	20				
	16	16	47	21	15	45			40	65	35	21	45					
8	17	17	49	1	16	0	9	by Boris- thenes.	31	41	65	47	22	0	21			
	18	18	50	34	16	15			42	66	58	22	15					
9	19	19	51	59	16	30	10	by En- glande.		43	66	7	22	30	22			
	20	20	53	17	16	45				44	66	15	22	45				
10	21	21	54	30	17	0	11			32	45	66	21	23	0	23		
	22	22	55	36	17	15				46	66	25	23	15				
11	23	23	56	38	17	30	12				47	66	29	23	30	24		
	24	24	57	34	17	45					48	66	31	23	45			
									33	49	66	31	2	24	0			

with

with the quantities of their longest dayes, and the Ele-  
vation of the Pole.

Parallels after Ptol.	Parallels more exact	Elevation of the Pole.		Quantity of the longest daye.			Parallels after Ptol.	Parallels more exact	Elevation of the Pole.		Quantity of the longest daye.	
		Deg.	Mi.	Dal.	Ho.				De.	Mi.	Dal.	Ho.
34	50	67	0	23	11			74	79	0	127	19
	51	67	30	33	17			75	79	30	130	17
	52	68	0	41	14			76	80	0	133	13
	53	68	30	48	6			77	80	30	136	8
	54	69	0	54	3			78	81	0	139	3
	55	69	30	59	12			79	81	30	141	21
35	56	70	0	64	11			80	82	0	144	14
	57	70	30	69	4			81	82	30	147	7
	58	71	0	73	13			82	83	0	150	0
	59	71	30	77	17			83	83	30	152	16
	60	72	0	81	17		38	84	84	0	155	8
	61	72	30	85	14			85	84	30	158	0
36	62	73	0	89	8			86	85	0	160	15
	63	73	30	92	22			87	85	30	163	5
	64	74	0	96	10			88	86	0	165	19
	65	74	30	99	21			89	86	30	168	9
	66	75	0	103	5			90	87	0	170	23
	67	75	30	106	11			91	87	30	173	13
	68	76	0	109	16			92	88	0	176	2
	69	76	30	112	20			93	88	30	178	16
	70	77	0	115	22			94	89	0	181	5
	71	77	30	118	22			95	89	30	183	19
37	72	78	0	121	22			96	90	0	186	7
	73	78	30	124	21							

Howe be it bicause you shall know what names thelder gre-  
kes dyd giue them (whyche names hath beene retayned euer  
sith that time) I haue here drawen a lyke table as your other  
authors haue sette forthe, that you may the better conferre  
the figure with the table, and the more easilye vnderstande  
the one by the other. in whiche figure the circle A, B, C, D,



representeth  
the Hori-  
zont, & the  
righte line  
A C, stan-  
deth for the  
Meridiane  
line. A is  $\bar{p}$   
north pole  
and C, the  
south pole.  
B the easte,  
& D  $\bar{p}$  west.  
B D beto-  
kening the  
Equinocti  
all, and EF  
the tropike

of Cancer, GH, the tropike of Capricorne. and al the other lines are the boundes of the Climats eche in his order. The first Climat taketh name of Meroe, a famous Iland in Ethiopia vnder Egypt, inclosed by the riuer Nilus. the secōd Climat is named of Syene, a city of Egypt, lying directli vnder þ tropik of Cancer. The third Climate is called after Alexandria, a notable city & an anciēt vniuersity in egypt also, lying on the north shore of it. The fourth climate beareth þ name of þ Rhodes, an issland better knowē then kept, and yet better losse then kepte so derely. The fiste Climate is expressed by the name of Rome, a citye in Italye well ynoughe known.

# The

The sixte climate is called after the Euxine sea, commonlye called Ponte. The seuenth Climate reacheth from the parallele that passeth by the mouthe of the riuer Boristhenes, and extendeth to the parallele that runneth by the south partes of Englande, as Ptolemy witnesseth in the second booke of his Almagestes. And although more maye bee saide of the Climates, yet I will reserue it to the treatise of Cosmographie, and at this time will saye no more, but that on the other side of the Equinoctiall towarde the Southe, there are the like Paralleles, and the like Climates, with the same quantities of distaunce from the Equinoctiall, and the like increase of daies.

*The southe  
Climates.*

Scholar. The distaunce of anye Climate or Parallele frome the Equinoctiall is equall all wayes with the eleuation of the Pole aboue the Horizonte, as I maye easlye coniecture: so that when I knowe the one, I muste needs knowe the other: and that maketh me nowe to thinke that yf I knowe anye eleuation of the Pole, I maye by this table easlye declare howe farre that Parallele whiche serueth for that eleuation, is frome the Equinoctialle circle: and howe longe the longest daye is in that place: and if it chaunce that the latitude of anye region whiche I doo seeke for, bee not in this table iustelye expressed, I muste then gesse by the proportion of those twoo numbres, betweene whiche it standeth, what the precise lengthe of the longest daye is.

*The vse of  
the table of  
Climates.*

Master. This table it selfe suffiseth for eche quarter of an hower betweene the longest nighte of 24 howers, and the longest daye of 24 howers: but for more exacter partes of tyme, I woulde not wishe you to trauaile yet, tyll I maye hereafter gyue you full rules for it: especiall ye seeynge this quarter of the hower is the difference of the whole daye, whiche muste be parted into twoo partes, and the one halfe quarter to bee assygned to the

R.i.

difference

difference of the Sonne risinge, and the other halfe quarter the difference of the sonne settinge.

Scholar. That difference is more precise then our clocks or dials do serue vnto, and therefore I may well ynoughe be satisfied with it for this time: wherefore I pray you now proceede to the Ascensions.

Of the Ascensions.

Master. The vse of the name of the Ascensions, hath great diuersitye in it, therefore I muste by diuision and definition distincte so those diuers varieties, that you may iustly knowe them eche in his kinde. And fyrst, for the name of Ascension in generall, it doothe betoken the risinge of anye starres or signes (what so euer they be) aboue the Horizont. But nowe is there dyuers obseruations of seuerall persons touching the risinge of the starres, for Astronomers vse to obserue theyr rysinge in fourme, that is to saye, whether they ryse ryghte or obliquely; not regardynge (in that consideration) the difference in the time of the daye: where as the conninge Maryners, and authors of husbandrye, yea and good Physicians also as well as Astronomers do marke their risinge at twoo times principallye, that is when they rise iuste at the Sonne settinge, or els iuste at the Sonne rysinge.

Scholar. If Astronomers doo consider onely the fyrste forme, then these other formes do not appertaine to this treatise, whiche is of Astronomie peculiarly.

Master. Althoughe those risinges and settinges of the starres which Physicians and other good writers of husbandrye and writers also of nauigation, doo ofte times speake of in their writinges, as beyng such, whiche in aunciente Kalendars haue beene sette forth plainlye for all menne to vnderstande, and so myghte bee at this tyme also, yet he that shoulde well sette theym so forthe, oughte to bee skylfull in Astronomie, els canne hee not doo it woorthy the readyng, and therefore it belongeth to Astronomers to determine

determine their true times. Howe bee it bycause Poetes haue oftener made mention of suche rysinges, then Astronomers haue doone; therefore doothe Ioannes de Sacro Bosco and others also call them Ascensions Poeticall: not as fayned matters, but as thinges often remembred in Poetes bookes. And as I sayde, they putte difference betweene the rysynge of those starres in the mornynge wyth the Sonne, and the rysynge of the same at the Sonne settinge. The fyrste manner of rysinge with the Sonne, they call in Latine, Ortus Cosmicus, Mundanus and Matutinus: whiche maye well bee named in Englyshe the Mornynge rysinge: the other sorte whiche in English ought to bee called the Euenynge rysinge, is named truely in Latine ortus Vespertinus or Acronychus, and not Temporalis or Chronicus.

Scholar. Yet manye doo call it so, and Ioannes de Sacro bosco sheweth a reason of that name, bicause (sayth he) that Astronomers vse that time after the Sonne settinge best for markinge the course of the starres.

Master. Ignorance of the Greeke tongue hathe hindred muche manye good wittes: whiche maye often appeare not only in good Iohn de sacro bosco, but also in many writers within these 300. yeares especiallye: but wee muste wynke at suche faultes, whiche rather were the faultes of the time, then of the persons. and for this name Acronychus, is easilye tourned into Chronicus. The fyrste name is often readde in Ptolemye and other Greeke wryters, and is named of the begynnyng of the nyghte, whiche name by ignoraunce was tourned into Chronicos in Greeke, and so accordinglye was called Temporalis in Latine, and then an ymagined reason clouted thereto: lykewaies also in the thyrde kinde of rysynge and settinge, whereof the same author doothe make mention, hit appeareth that hee was somewhat deceaued, for that oughte not to bee called proprelye rysynge of anye Starre

R.ij.

when

The thyrde  
kinde of  
settynge.

Combustio.  
Oppression

when it getteth oute of the Sonne beames, and maye shewe or shine at eueninge or mornynge. but it oughte rather to be called Apparition or appearynge of that starre. And contrarye wayes when anye starre is so nyghe vnto the Son that the Sonne doothe take awaye or hyde the lyghte of it, it oughte to bee called the Hydynge or occultation of that starre, and not the settinge of that starre, syth settinge and rysynge haue propre relation to the Horizonte, and yet doothe hee and mennye other contrarye to the learned Greekes call the fyrste, the Sonnelye rysynge of the starre, and the other, the Sonnelye settinge of him. where as Ptoleme and the learned Greekes call the one *φανος*, that is in Latine Apparitio, the shewynge of the starre, and the contrarye is called in Greeke *συνελπισμος*, and in Latine Occultatio, the darkenynge or hidynge of the starre, whiche chaunce happeneth commonly to any starre being within 15 degrees of the Sonne. this passion is called of many men Combustion: Other contract the name of combustion to syxe degrees, and call this Oppression. but of all these, I will an other time declare my full mynde, for the iuste knowledge hereof appertaineth to a higher Arte. And so will I hereafter giue you a table declaringe the morninge and euenynge rysynge and settinge of all the moste notable starres, for the matter is not so easye as it seemeth to bee.

Scholar. I vnderstande it thus: that when the Sonne is in anye parte of a Signe, those starres whiche be in the same parte of that Signe, doo rise with the Sonne, and those whiche be in the like degree of the contrarye signe, they rise at the Sonne settinge.

Master. Your taking is true, for suche starres as are nigh vnto the Ecliptike line: but yet such starres as be farre from the ecliptike line, may rise or set with the Son, although they be in an other Signe then the Sonne is, & so may they rise or set before or after y<sup>e</sup> son, although they be in one degree of any  
signe

Signe with the Sonne. And here maye you not forgette that the starre that setteth with the Sonne, is named to haue an euening setting: and the starre that setteth in the weste at the Sonne rising, is iudged to haue the morning setting: whereby it foloweth, that the starre that hath the morning rising, hath also the euening setting: and he that hath the eueninge risinge, hath the morning setting: thus haue I spoken rudely and lyghtly for this time, but in the table of these risings and settings, you shall haue a more exacte forme of knowledge set out for you, touching this matter. And nowe to re-  
 tourne to those ascensions which be peculiarly called Astro-  
 nomicall, fyrste, for the definition you muste vnderstande,  
 that Ascension astronomicall is the certaine limitation of  
 som pointe of the equinoctiall circle, whiche riseth iustelye  
 with anye starre, and largely taking the vse of that name. It  
 betokeneth also the arke of the Equinoctiall circle, whiche  
 lyeth betweene the beginnynge of the same Equinoctiall at  
 Aries, and extendeth to the iuste degree that riseth with any  
 starre or signe. Thirdly the ascension of a signe or constel-  
 lation (whiche includeth a certaine measure in lengthe,) is  
 that iuste arke of the equinoctiall, which doth passe the Ho-  
 rizont with that whole signe or constellation.

The eue-  
 ning settig  
 The mor-  
 ning settig

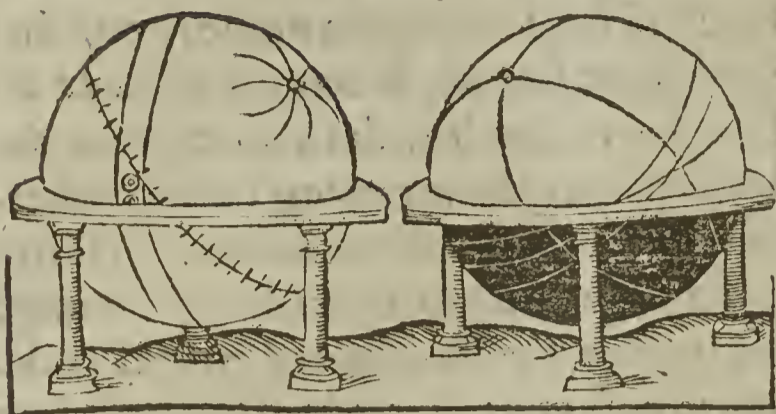
Ascensio as-  
 tronomical

This ascension is commonly dyuided into twoo kyndes, the one is called Ryghte ascension, and the other Oblique or Crooked ascension. Ryghte ascension, is defined to bee that, with whiche a greater portion of the Equinoctiall dooth ascende. And that is called Crooked or Oblique ascension, with whiche a lesser portion of the Equinoctiall doth ascende.

Ryght as-  
 cension.  
 Croked as-  
 cension.

Scholar. I heare you speake of a lesser portion and a greater portion, but where vnto those comparisons ought to be referred, I can not tell, excepte I shall referre the one to the other.

Master. That maye you not doo, for so one ascension myghte



mighte bee called right & crooked also, at the least in diuers comparisons: but that can not be, neither is it permitted by any astronomers Scholar. How may

it appeare that suche absurditie woulde follow?

The meane  
Ascension.

Master. To the intente that I maye alleage nothinge, but that whiche shall not only be certaine and true, but also shall be manifest to you, I will firste instructe you in the vnderstanding of those Ascensions, and after that I will return to the proof of these my woordes. And for the better vnderstandinge of both definitions, I will name vnto you a thirde Ascension, which must be as the rule of those other 2, and that is the Meane ascension, for seyng you can not well refer greater and lesser but other to one common meane, or els eche to other: and I haue said before (and wil proue it anon) that they can not be compared togiether, therefore must they bee referred and compared to one common meane, whiche I call the Mean ascension, bicause that with it ther ascendeth not so muche of the Equinoctiall, as with the right ascensio, nor so lytle as doth ascende with the crooked ascension. and for this cause may it well be called a Mean ascension. Again it maye be called a Meane ascension, bicause it is without all excesse: for the portion of the Equinoctiall whiche ascendeth with it, is equall to it in precisenes of degrees, so that neither of them exceedeth other.

Scholar. It seemeth reasonable that all excesses beinge referred to anye one thinge, do approue that one as a meane betwene them, namely when the excesses decline to both extremities, as more and fewer, greater & lesser do. but in al this kinde of doctrine, the wordes are more easye to bee vnderstande, then the matter. Therefore excepte ye do with exam-  
ples

ples declare these varieties of Ascensions, I doubt it wyll be longe before I shall well conceaue them and rightlye distyncte them.

Master. You haue learned before, that there is two varieties of Spheres, a Righte Sphere, and a Bowing sphere: and as in eche of these the Equinoctiall doth kepe one vniforme ascension, that is to say,  $\frac{1}{2}$  in 24 houres iustlye all the equinoctiall doth ascende, and so consequently in euerye hower of the daye 15 degrees of the Equinoctiall doo passe the righte horizon, so the Zodiake whiche is the circle of the signes, by meanes of his obliquitie, dooth not keepe vniforme ascension anye where in any position of Sphere. for although the whole Zodiake do ascend iustly in 24 howers, yet in euery hower, vnequal portions of it do ascend, and that diuersly, according to the diuersities of the Climates. But in a generaltye of differences, you may take these generall rules.

Certain generall rules  
in a righte  
Sphere.

In the right sphere, euerye quarter of the Zodiak hath an equall or Meane ascension, with euery quarter of the equinoctiall, beginning the quarters at the 4 principall points, whiche I haue before set forth: for if you shoulde take three signes in other partes of the Zodiak, their ascensions wyll not agree with a quarter of the Equinoctiall, sith there is no one signe that doth equally agree in ascension with the lyke portiō of the Equinoctiall, that is to say, with 30 degrees in it.

Scholar. This rule is in Ioannes de Sacro bosco, and in Orontius also.

Master. Then you beleue it the better.

Scholar. Yea in deede.

Master. Then tell me whether the ascension of one of those quarters of the Zodiake, ought to be called a Right ascension, or a Crooked ascension.

Scholar. Neither of bothe, as I do vnderstande their definitions, seeyng the arke of the Equinoctiall that ascendeth with them, is nother greater nother yet lesser then they, as these definitions do importe, but is equal with them, and there

therfore it seemeth to me more apte to call it a Meane ascension after your definition.

II. Master. You saye truthe, and therefore is their doctrine imperfecte, that make but two ascensions, where thre ought to be distincte, (and them selues name thre in vse, and but 2 in distinction and definition) namely seyng (as Tullye hath sayd) it is the greatest faulte that can be, to omitte any membre in diuision; but to omitte their faultes in omission, and to retourne to their better declaration. This second rule do they also approoue, yea and natures ordre doth necessarily inferre the same, that euerye twoo signes or partes of Signes equall in quantitie, and lyke distaunte from anye one of the 4 principall pointes, haue equall ascensions eche to other.

Scholar. That is to meane, that Taurus, and Aquarius haue equall ascension, bicause they are equally distaunt from the Equinoctiall pointe of Aries.

Master. And so haue Taurus and Leo, bicause they differre equallye frome the Tropicall pointe of Cancer, and so of all the other. But to the intente that you maye the better vnderstande all this that is saide, and the reste that is to be saide, I haue here set forth in a table the iuste numbres of degrees of the Equinoctiall circle, which do answer to the degrees of euery signe in their ascensions in the right Sphere. So that if you desire to knowe the ascension of any degree of anye signe, firste seeke out the signe, and then in the firste columnne looke for the noumbre of the degree, against whiche in the common corner vnderneath the Signe you may see the numbre of the degrees and Minutes of the Equinoctiall, that do ascende with that degree of the signe. And those degrees be accompted frō the beginning of the Equinoctiall at Aries, and so orderly after þ natural course of the signes. wherby you maye perceauē, that Aries, Taurus and Gemini all three together haue for their ascension 90 degrees, whiche numbre agreeth with the quantitie of 3 signes, and therefore is their ascension Meane. Also I maye say

## A TABLE FOR THE ASCENSIONS

of the twelve Signes in the Righte  
Sphere.

Degrees of Signes.	Aries		Taurus		Gemini		Cancer		Leo		Virgo	
	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.
1	0	55	28	52	58	51	91	5	123	14	153	3
2	1	50	29	49	59	54	92	11	124	16	154	0
3	2	45	30	47	60	57	93	16	125	18	154	57
4	3	40	31	45	62	0	94	22	126	20	155	54
5	4	35	32	43	63	3	95	27	127	21	156	50
6	5	30	33	41	64	7	96	32	128	23	157	47
7	6	26	34	39	65	10	97	37	129	24	158	44
8	7	21	35	38	66	14	98	43	130	25	159	40
9	8	16	36	36	67	18	99	48	131	26	160	36
10	9	11	37	35	68	21	100	53	132	27	161	32
11	10	7	38	34	69	26	101	59	133	28	162	28
12	11	2	39	33	70	30	103	3	134	28	163	24
13	11	57	40	33	71	34	104	8	135	28	164	20
14	12	53	41	32	72	38	105	12	136	28	165	16
15	13	49	42	32	73	43	106	17	137	28	166	11
16	14	44	43	32	74	48	107	22	138	28	167	7
17	15	40	44	32	75	52	108	26	139	27	168	3
18	16	36	45	32	76	57	109	30	140	27	168	58
19	17	32	46	32	78	2	110	34	141	26	169	53
20	18	28	47	33	79	7	111	39	142	25	170	49
21	19	24	48	34	80	12	112	42	143	24	171	44
22	20	20	49	35	81	17	113	46	144	22	172	39
23	21	16	50	36	82	23	114	50	145	21	17	34
24	22	13	51	37	83	28	115	53	146	19	174	30
25	23	10	52	39	84	33	116	57	147	17	175	25
26	24	6	53	40	85	38	118	0	148	15	176	20
27	25	3	54	42	86	44	119	3	149	13	177	15
28	26	0	55	44	87	49	120	6	150	11	178	10
29	26	57	56	46	88	55	121	9	151	8	179	5
30	27	54	57	49	90	0	122	11	152	6	180	0

THE FOURTH TREATISE OF  
THE SECOND TABLE OF THE  
Ascensions of the twelve Signes in the Righte  
Sphere.

Degrees of Signes.	Libra		Scorpius		Sagittari.		Capricor.		Aquarius		Pisces	
	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.
1	180	55	208	52	238	51	271	5	303	14	333	3
2	181	50	209	49	239	54	272	11	304	16	334	0
3	182	45	210	47	240	57	273	16	305	18	334	57
4	183	40	211	45	242	0	274	22	306	20	335	54
5	184	35	212	43	243	3	275	27	307	21	336	50
6	185	30	213	41	244	7	276	32	308	23	337	47
7	186	26	214	39	245	10	277	37	309	24	338	44
8	187	21	215	38	246	14	278	43	310	25	339	40
9	188	16	216	36	247	18	279	48	311	26	340	36
10	189	11	217	35	248	21	280	53	312	27	341	32
11	190	7	218	34	249	26	281	58	313	28	342	28
12	191	2	219	33	250	30	283	3	314	28	343	24
13	191	57	220	33	251	34	284	8	315	28	344	20
14	192	53	221	32	252	38	285	12	316	28	345	16
15	193	49	222	32	253	43	286	17	317	28	346	11
16	194	44	223	32	254	48	287	22	317	28	347	7
17	195	40	224	32	255	52	288	26	319	27	348	3
18	196	36	225	32	256	57	289	30	320	27	348	58
19	197	32	226	32	258	2	290	34	321	26	349	53
20	198	28	227	33	259	7	291	39	322	25	350	49
21	199	24	228	34	260	12	292	42	323	24	351	44
22	200	20	229	35	261	17	293	46	324	22	352	39
23	201	16	230	36	262	23	294	50	325	21	353	34
24	202	13	231	37	263	28	295	53	326	19	354	30
25	203	9	232	39	264	33	296	58	327	17	355	25
26	204	6	233	40	265	38	298	0	328	15	356	20
27	205	3	234	42	266	44	299	3	329	13	357	15
28	206	0	235	44	267	49	300	6	330	11	358	10
29	206	57	236	46	268	55	301	9	331	8	359	5
30	207	54	237	49	270	0	302	11	332	6	360	0

saye, that the laste degree of Gemini, or anye starre in that degree, or in the laste degree of Virgo, Sagittarius or Pisces, haue a Meane Ascension, so that the same starre haue no latitude: how be it in the eande of Gemini and Sagittarye, althoughe they haue neuer so muche latitude, yet is their ascension meane. whiche prerogatiue those two points haue, bicause the lynes or circles of their longitudes doo touche bothe the Poles of the Zodiake and of the Equinoctiall, and so dothe no other circle of longitude: wherefore all starres out of those places limited where so euer they be, they haue no Meane ascension, but other Ryghte ascension, or els Crooked.

Scholar. Thus I perceauē that the two tropike pointes haue a priuiledge aboue the two equinoctiall pointes in the ascensions.

Master. It seemeth so in the righte sphere, but in the Oblique sphere the Equinoctiall pointes haue the greater priuilege: for alwaies in all places where they doo ascende, they keepe their meane ascension, but so dooth not the tropike pointes in anye oblique sphere. no nother anye starres of their longitude, that is to saye in their Colure, for although two pointes in the skie, where their Colure dooth cutte the Equinoctiall circle, haue a meane ascension, yet in those 2. places is there no starre that hath beene noted, as hereafter you shall better vnderstand. But that you maye in the mean season knowe what signes doo ascende righte, and which do ascende crookedlye in the righte sphere, you shall marke this lytle table whiche I haue drawn out of the former great table, where you see that 4 signes agree styll in their ascension, and the firste 4 haue but 27 degrees and 54 minutes of the Equinoctiall answering to eche of their ascensions: the other 4 signes haue 29 degrees, 55 minutes for their ascension: and the laste 4 haue 32 degrees and 11 minutes agreeing to theyr rising, which degrees and minutes added togitier, do make iuste 90 degrees that is exactelye one quarter of the equinoctiall

THE FORTH TREATISE OF  
A brieft table for the righte Sphere.

Ascension	The twelue Signes.				Partes of the Equinoctiall		Partes of tyme	
					Deg.	Min.	Ho.	Min.
Crooked	Aries	Virgo	Libra	Pisces.	27	54	1	51 $\frac{5}{6}$
Crooked	Taurus	Leo	Scorpius	Aquarius	29	55	1	59 $\frac{2}{3}$
Ryghte	Gemini	Cancer	Sagittarius	Capricornus	32	11	2	8 $\frac{11}{15}$
The addition of those partes eche to his owne kinde					90	0	6	0

ctiall and so are eche ternary of those Signes one iuste quarter of the Zodiake.

Scholar. And in like case I perceave, the 6 howers of time that answereth to those whole quarters, is also the iuste quarter of the naturall day, which amounteth by the addition of the three severall times agreing to those 3 severall ascensions. And as I vnderstand it, the quantitie of tyme is gathered after the rate of 15 degrees ascendinge euerye hower, as you saide before. so that euerye degree asketh 4 minutes of an hower: and 15 minutes of a degree in the Equinoctiall doo ryse in one minute of an hower: for this is alwaies to bee remēbred, that a minute is euermore the 60 part of that thyng whervnto it is referred. But now ther commeth to my mind the sayinge of Ioannes de Sacro Bosco, whiche longe hath troubled my minde, and I can not learne of anye man howe to vnderstande him well: for in mine opinion his woordes import an impossibilitie. he blameth this argument as euell: These two arkes are equall, and they begin to rise together, and continually ther riseth a greater portion of the one arke then of the other: ergo that arke will bee full risen soonest, whose greater portion did alwaies rise. This argumente seemeth inuincible in mine opinion, and yet Iohn de Sacro bosco for improving of it alleageth an example, wherby as he seemeth to intend, the antecedent maye be true, and the consequente false: and therefore the argumente muste needes be naught.

Master. Repeat you his example, that we may examine it.  
Scholar.

Scholar. He willeth to take any quarter of the Zodiake, compared with his like quarter of the Equinoctiall, and to begin with that quarter from the fyrste pointe of Aries, to the latter ende of Gemini, alwaies the greater portion riseth of the Zodiake, and the lesser of the equinoctiall, and yet those two quarters ascend fully together: and the lyke muste you vnderstande of the thirde quarter, from the beginning of Libra, to the eande of Sagittarye. but contrarye waies, in the quarter that lyeth frome the fyrste parte of Cancer, to the laste of Virgo, the portion of the Equinoctiall in rysynge, is styll greater then the parte of the Zodiake that riseth with it: and yet those bothe arkes doo rise iustly together at the eande.

Master. Here is a greate fallation by Amphibologye, as Logicians do call it, so that in one sence it maye be true, and in an other it is false. And fyrste for declaration of Iohn his meaning (as I thinke) marke as many partes of those 2 fyrste quarters as you lyst, and still by the former table, as well as by tournynge the Sphere it selfe, it wyll appeare manifestly, that the portion of the Zodiake is euer greater then the matche portion of the Equinoctiall.

Scholar. That is moste true. for with 12 degrees of Aries there ascendeth of the equinoctiall 11 degrees and twoo minutes only of the Equinoctiall, that is 59 minutes lesse: with 30 degrees of Aries there riseth but 27 degrees and 54 minutes, whiche is lesse by two degrees and syxe minutes: also in Taurus, 15 degrees hath for their ascension 42 degrees and 32 minutes, that is twoo degrees and 28 minutes to lytle: the laste of Taurus ascendeth with 57 degrees and 49 minutes, whiche shoulde be 60 if it were equall with the degrees of the Zodiake. Againe the 16 degree of Gemini answereth to the ascensio of the 74 degree and 49 minute of the equinoctial, whiche in equalitye would be 76: and the 29 degree of Gemini should haue by ordre of equalitie the 89 degree of the equinoctial, & hath but 88 degrees & 55 minuts, which is lesser.

S.i.

by five

by 5 minutes then equalitye requireth, and so doth it appear in all the reste, saue in the verye laste degree of Gemini, wher bothe numbres appeare euen.

Mastr. Then are the wordes of Iohn de sacro bosco true.

Scholar. This matter troubleth me to muche: for of this am I assured, that if anye two quantities be equall togyther, and a lesser portiō of the fyrste matched with a greater part of the second, then of necessitye that parte that remaineth of the fyrste quantitie, must needes be greater then that that resteth of the seconde.

Master. That is true also: for if you abate vnequall partes from 2 equall quantities, the portions that remaine will be vnequall, and that parte will bee leaste, frome whiche the greater portion was abated.

Scholar. As that can not be false, so it seemeth to me, that seyng there doth ascende with the whole signe of Aries but 27 degrees, and 54 minutes, there must needes remain 62 degrees and 6 minutes of that quarter, and that is more then the 60 degrees which resteth of the like quarter of the Zodiacke. Now those 62 degrees and 6 minutes will ascend with the 60 degrees of the Zodiacke, so that then there dooth not styll ascende a lesser portion of the Equinoctiall: for as the fyrste portion was lesser, so this seconde parte is greater.

Master. Your coniecture is good: and to approue it the better, you may conferre some lesser partes of those 2 quarters togyther, as from the 20 degree of Taurus, to the 10 degree of Gemini, the degrees betweene them are 20: & to know the arke of the equinoctiall that ascendeth with those 20 degrees, subtracte the lesser from the greater, and the ascension of those 20 degrees wyll remayne.

Deg.	Min.
68	21
47	33
20	48

Scholar. The ascension of the 20 degree of Taurus is 47 degrees and 33 minutes: the ascension of the 10 degree of Gemini is 68 degrees, and 21 minutes. wherfore setting those numbres in conuenient ordre, and making subtractiō duly, ther resteth 20 degrees & 48 minuts, so is this portiō of the equinoctiall

noctiall the greater by 48 minutes.

Master. Proue again from the 28 degree of Taurus, to the 28 degree of Gemini: whiche difference is 30 degrees.

Scholar. With the 28 degree of Taurus there dooth ascende 55 degrees, and 44 minutes: and with the 28 of Gemini, 87 and 49. and by Subtraction the difference

appeareth to bee 32 degrees, and 5 minutes. so is the arke of that Equinoctiall greater by two degrees and 5 minutes, then the matche arke of the

$$\begin{array}{r} 87. \quad 49 \\ 55 \quad 44 \\ \hline 32 \quad 5 \end{array}$$

Zodiake. And therefore are not Iohn de Sacro bosco his woordes true.

Master. Prooue yet more before you condemne him, try the arke from the tenth degree of Taurus, to the 22 degree of the same signe, whiche arke includeth 12 degrees of the Zodiak.

Schol. The 10 degree of Taurus, ascendeth with 37 degrees & 35 minutes of the equinoctial: & 22 degree of the same sign hath for his ascensio 49 degrees & 35 minutes, & difference between 49 35 them by subtractio is found to be 12 degrees iust: and 37 35 so that arke of the Equinoctiall is equall with his 12 0 matche arke in the Zodiake.

Master. Yet ones more proue the arke from the last degree of Aries to the second degree of Gemini, which ark is 32 degrees.

Scholar. The last degree of Aries riseth with 27 degrees, and 54 minutes: and the 2 of Gemini hath 59 degrees and 54 minutes in his ascension. betwene which 2 numbres, the distaunce is 32 degrees exactly, and so are those 2 arkes equall also, and neither of those 2 examples do make the arke of the Equinoctiall lesser then the matche arke in the Zodiake: so that they make agaynst Iohn de Sacro bosco.

Master. In deede as his woordes be placed in the Present time, they can not be true, but his meaning may be more fauourably gathered, by turning the Present time into the Perfect time, & referring the name of ascension to the whole arke.

S.ij.

that

that is fully ryſen in that quarter, as I dyd in the explication of his wordes. occasion you to make prooffe: wherefore take anye parte of the fyrſte quarter, and accompt from the beginninge of Aries: or lykewaies any part of the thyrd quarter, and reckon from the beginning of Libra, and ſo ſhall you ſee alwaies that the portion of the Zodiake whiche is aſcended, ſhall be greater then the parte of the Equinoctiall that is riſen with it: & ſo ſhall it continue euen to the very laſte degre of them bothe, and then at length doth both the quarters end their aſcenſions exactly together.

Scholar. As you ſaye. nowe doo I perceauē it, ſo that the faulte is rather in his woordes then in his meanyngē.

Maſter. Such meane matters muſt be winked at in other, but not folowed. And nowe for the ordre of Aſcenſion of the other 2 quarters which begin at Cancer & Capricorne, you ſhall vnderſtand the lyke: but that the greater portion that aſcēdeth is referred to the Equinoctial circle & not to the Zodiak.

Scholar. So I vnderſtand by this former table that with the 28 degree of Cancer there aſcendeth 120 degrees and 6 minutes of the Equinoctiall, which is two degrees and 6 minutes more then equality woulde yelde: and with the 26 degree of Virgo, there riſeth the 176 and 20 minutes of the Equinoctiall, whiche is alſo more then equalenes by 20 minutes: and ſo if I take anye degre of any ſigne in that ſecond quarter, or in the fourth quarter, beginning at Capricorn, I may lyghtly ſee by the table that the portion of the Equinoctiall in his aſcenſion is greater then the matche arke of the Zodiak from the beginninge of Aries to that degre. wherby it appeareth that al thoſe 6 ſignes do aſcend right, bicauſe a greater portiō of the Equinoctiall aſcēdeth with thē.

Maſter. Then by the like reaſon, the other 6 ſignes Aries, Taurus, Gemini, Libra, Scorpius and Sagittarius do aſcend crokedly, bicauſe the leſſer portiō of the Equinoctial doth aſcend with thē: after the ſort of conferēce, which is cōtrary to what I ſaid before, the 4 ſignes only do aſcend ryght in the Ryght ſpher: wher-

wherefore you muste vnderstande, that for to knowe the ascension of euerye signe, you must consider that signe alone, and the arke of the Equinoctiall that dooth ascend with it, and so shall you see exactly the ascension of euerye signe seuerally. And here you shall vnderstande, that all Astronomers commonly do call the Right ascension so largely, that it extēdeth to the ascensio of all the signes in a Right sphere: and so they name the Oblique ascension the rising of all the Signes in anye Oblique Sphere, whereby it appeareth that they giue the name of Ryghte and Crooked ascensions, accordinge to the Horizontes or positions of the Sphere, and not after the quantities of time in their ascension. And this shall suffice at this time touchinge ascensions in the Righte Sphere: in which also the descensions or settinges vnder the Horizont, are equall with the Ascensions, so that they need not to haue anye peculiare declaration: but in the Oblique Spheres it is not so, but contrary waies, those signes that do ascende righte, doo descende crooked: and they that ascende crooked, doo descend righte: so that the descension of anye signe in an Oblique sphere, is equall precisely to the ascensio of the contrarye signe.

Schollar. You meane that the descending of Aries is equal to the ascendinge of Libra, and the descendinge of Taurus is one in quantity of time with the ascension of Scorpius.

Master. So is it in deed. And in this greate varietie you shall marke one constaunte vniformitie, that the ascension and descension of any signe in any crooked sphere ioyned by addition togiether, doo make an equall summe of time with the ascension and descension of the same signe in a righte sphere, in lyke sorte ioyned togiether: but to the intente that you maye vnderstande all these thinges the better, and also knowe the iuste ascension of euerye signe in this our Climat where the eleuation of the pole is 52 degrees, I haue drawen heere a speciall table for that latitude. in whiche you shall vse the like manner of entringe, as you did in the other, so that

S. in,

although

*An other signification  
of right ascension.*

*Of the descension of  
Signes.*

THE FOURTH TREATISE OF  
A TABLE OF ASCENSION OF  
the Signes in 52 degrees of Latitude.

Degrees of Signes.	Aries		Taurus		Gemini		Cancer		Leo		Virgo	
	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.
0	0	0	12	48	29	42	56	11	94	6	137	0
1	0	24	13	16	30	24	57	17	95	30	138	37
2	0	48	13	45	31	7	58	24	96	54	139	54
3	1	13	14	14	31	50	59	31	98	18	141	20
4	1	37	14	43	32	34	60	39	99	42	142	47
5	2	2	15	12	33	18	61	48	101	7	144	13
6	2	26	15	42	34	3	62	58	102	32	145	40
7	2	51	16	13	34	49	64	9	103	57	147	6
8	3	15	16	43	35	36	65	20	105	22	148	32
9	3	40	17	14	36	24	66	32	106	47	149	58
10	4	5	17	45	37	12	67	45	108	12	151	24
11	4	30	18	16	38	1	68	59	109	38	152	50
12	4	55	18	48	38	51	70	13	111	4	154	16
13	5	20	19	20	39	42	71	28	112	30	155	42
14	5	45	19	52	40	34	72	44	113	56	157	8
15	6	10	20	25	41	26	74	0	115	23	158	39
16	6	35	20	59	42	19	75	17	116	49	160	0
17	7	1	21	34	43	13	76	34	118	15	161	26
18	7	26	22	8	44	8	77	52	119	42	162	52
19	7	52	22	43	45	3	79	11	121	8	164	18
20	8	18	23	18	45	59	80	30	122	35	165	43
21	8	44	23	54	46	56	81	50	124	2	167	9
22	9	11	24	31	47	54	83	10	125	28	168	35
23	9	37	25	8	48	53	84	31	126	55	170	1
24	10	4	25	45	49	53	85	51	128	22	171	27
25	10	31	26	23	50	54	87	12	129	48	172	52
26	10	58	27	2	51	56	88	34	131	15	174	18
27	11	25	27	41	52	59	89	57	132	41	175	44
28	11	53	28	21	54	2	91	20	134	8	177	9
29	12	20	29	1	55	6	92	43	135	34	178	35
30	12	48	29	42	56	11	94	6	137	0	180	0

Degrees  
of Signs

	Libra		Scorpius		Sagittari.		Capricor.		Aquarius		Pisces	
	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.
0	181	0	223	0	265	54	303	49	330	18	347	12
1	181	25	224	26	267	17	304	54	330	59	347	40
2	182	51	225	52	268	40	305	58	331	39	348	7
3	184	16	227	19	270	3	307	1	332	19	348	35
4	185	42	228	45	271	26	308	4	332	58	349	2
5	187	8	230	12	272	48	309	6	333	37	349	29
6	188	33	231	38	274	9	310	7	334	15	349	56
7	189	59	233	5	275	29	311	7	334	52	350	23
8	191	25	234	32	276	50	312	6	335	29	350	49
9	192	51	235	58	278	10	313	4	336	6	351	16
10	194	17	237	25	279	30	314	1	336	42	351	42
11	195	42	238	52	280	49	314	57	337	17	352	8
12	197	8	240	18	282	8	315	52	337	52	352	34
13	198	34	241	45	283	20	316	47	338	26	352	59
14	200	0	243	11	284	43	317	41	339	1	353	25
15	201	26	244	37	286	9	318	34	339	35	353	50
16	202	52	246	4	287	16	319	26	340	8	354	15
17	204	18	247	30	288	32	320	18	340	40	354	40
18	205	44	248	56	289	47	321	9	341	12	355	5
19	207	10	250	22	291	1	321	59	341	44	355	30
20	208	36	251	48	292	15	322	48	342	15	355	55
21	210	2	253	13	293	28	323	36	342	46	356	20
22	211	28	254	38	294	40	324	24	343	17	356	45
23	212	54	256	3	295	51	325	11	343	47	357	9
24	214	20	257	28	297	2	325	57	344	18	357	34
25	215	47	258	53	298	12	326	42	344	48	357	58
26	217	13	260	18	299	21	327	26	345	17	358	23
27	218	40	261	42	300	29	328	10	345	46	358	47
28	220	6	263	6	301	36	328	53	346	15	359	12
29	221	33	264	30	302	43	329	36	346	44	359	36
30	223	0	265	54	303	49	330	18	347	12	360	0

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although the numbres differ, yet the woorke differeth not in this table. the fyrst columnne containeth the degrees of the Signes, and the other columnnes doo containe the degrees & minutes of the Equinoctiall vnder eche signe, accordingly as they doo answere to the Ascension of the degrees of the same Signes. By this table may you see a great diuersitie in the Ascensions from those in the Right Sphere: And yet this maye you certainly obserue: that euerye two signes beinge contrarye to gither, the one lyinge againste the other, as they haue farre vnlyke ascensions, so yet if you adde their bothe ascensions together, they will be equall to the ascensions of the same twoo signes in the Right Sphere.

Scholar. Then in as muche as the ascension of Aries is in this latitude 12 degrees and 48 minutes, & the ascension of Libra, 43 degrees iust, (abating as I ought 108 degrees) and so they bothe by addition do make 55 degrees, and 48 minutes. And in the right sphere eche of these signes hath for his ascension 27 degrees and 54 minutes (for the contrarye signes there are equall in their ascension) wherfore by addition there will amounte the same summe precisely that was gathered before: and so likewise of Taurus and Scorpius: their ascensions ioyned together maketh 59 degrees and 48 minutes: but in the right sphere, those two ascensions maketh 59, 50. that is twoo minutes only difference in two signes, so is it but one minute in one signe, that is not to be regarded.

Master. Not greatly, and especially in an Introduction. But doo you marke here the Signes that ascende ryght, and them that ascende crooked?

Schollar. Although I see a difference by this table from the other: I had thoughte that the more croked Sphere had made the more croked ascension onlye: but yet that they alwaies had kepte one name in generall, and not haue chaunged it. but by your question only I am admonished of mine

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errour: for I see that Libra (as it is easlye vewed) dooth ascend here righte, and hath for his ascension 43 degrees, and in the Righte sphere it dyd ascende crookedlye, and had but 27 degrees and 54 minutes for his ascension, and therefore maye I doubte of all the reste, tyll I haue examined theyr ascensions better.

Master. To ease you of payne, lo here is a table of theyr iuste ascensions, which you maye examine at leasure.

## A BRIEFVE TABLE FOR

52. degrees of latitude.

Ascension	The 12 Signes.	Parts of the Equin.		Partes of tyme.	
		Degrees.	Minutes.	Howers.	Minutes.
Crooked	Aries, Pisces,	12	48	0	51 $\frac{2}{15}$
Crooked	Taurus, Aquarius,	16	54	1	7 $\frac{9}{15}$
Crooked	Gemini, Capricornus	26	29	1	45 $\frac{14}{15}$
Ryghte	Cancer, Sagittarius,	37	55	2	31 $\frac{10}{15}$
Ryghte	Leo, Scorpius,	42	54	2	51 $\frac{9}{15}$
Ryghte	Virgo, Libra,	43	0	2	52
The addition of those partes		180	0	12	0

By this table you maye perceauē what signes doo rise crookedlye, and whiche doo ascend righte, and that there bee of eche sorte 6. so that from Cancer vnto Capricorne all the signes in direct ordre do ascende ryghte, and frome Capricorne to Cancer, in naturall ordre of the Signes, all those 6 signes do ryse crookedly. And this rule is generall in all these northe climates, that lye from 30 degrees of latitude (vnder which Memphis and Alcayre are and mounte Sinay: also the ysle of Madera, and the parte of the weste Indies, called Terra florida) vnto 66 degrees and a halfe of latitude, in that Climate wher Island lyeth and the north partes of Norwaye, and namelye Halgoland, where Oht here dwelte, that was the fyrste discouerer of the north viage towarde Moscouia.

Scholar. That viage I desire muche to vnderstande, and

so do manye other.

Master. An other time shall serue for it, for now we haue an other matter in hande.

Scholar. Then for this present matter: Is there anye other varietie of ascention betweene the Equinoctiall circle and the Latitude of 30 degrees?

Varietes of  
Ascensions.

Master. Yea, muche diuersitye: for (as you haue hearde) vnder the equinoctiall 8 signes do ascend crookedly, and but 4 ryght: but from the Equinoctiall vnto 10 degrees of latitude, 6 signes ascende ryght, (Gemini, Cancer, Leo, Scorpius, Sagittarius, Capricornus) and other syxe crooked, that is Aries, Taurus, Virgo, Libra, Aquarius & Pisces. And from 10 degrees vnto 30 there are 8 signes that rise right, as Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, and Capricornus: and the other four, Aries, Taurus, Aquarius and Pisces, rise crookedly. but to the intent that you may haue the better habilitie to iudge of suche varieties, I haue here sette forth diuers tables for examples sake: and namely suche, whiche importe anye varietie of alteration, or helpe to the apte vnderstandinge of the same.

### A TABLE FOR THE LATITUDE of .1. degree.

Ascention	The 12 Signes.	Parts of the Equin.		Partes of tyme.	
		Degrees.	Minutes.	Howers.	Minutes.
Crooked	Aries, Pisces,	27	42	1	50 $\frac{12}{15}$
Crooked	Taurus, Aquarius,	29	44	1	58 $\frac{14}{15}$
Ryghte	Gemini, Capricornus	32	8	2	8 $\frac{8}{15}$
Ryghte	Cancer, Sagittarius,	32	16	2	9 $\frac{1}{15}$
Ryghte	Leo, Scorpius,	30	4	2	0 $\frac{4}{15}$
Crooked	Virgo, Libra,	28	6	1	52 $\frac{0}{15}$
The summe of those partes		180	0	12	0

## A table for 10. degrees of latitude.

Ascension	The 12 Signes.	Partes of the Equin.		Partes of tyme.	
		Degrees	Minutes.	Howers.	Minutes.
Crooked	Aries, Pisces,	25	51	1	43 $\frac{6}{15}$
Crooked	Taurus, Aquarius,	28	14	1	52 $\frac{14}{15}$
Ryghte	Gemini, Capricornus	31	31	2	6 $\frac{1}{15}$
Ryghte	Cancer, Sagittarius,	32	53	2	11 $\frac{8}{15}$
Ryghte	Leo, Scorpius,	31	34	2	6 $\frac{4}{15}$
Crooked	Virgo, Libra,	29	57	1	59 $\frac{12}{15}$
The summe of those partes		180	0	12	0

## A table for 11 degrees of latitude.

Ascension	The 12 Signes.	Partes of the Equin.		Partes of tyme.	
		Degrees.	Minutes.	Howers.	Minutes.
Crooked	Aries, Pisces,	25	38	1	42 $\frac{8}{15}$
Crooked	Taurus, Aquarius,	28	4	1	52 $\frac{1}{15}$
Ryghte	Gemini, Capricornus	31	27	2	5 $\frac{12}{15}$
Ryghte	Cancer, Sagittarius,	32	57	2	11 $\frac{12}{15}$
Ryghte	Leo, Scorpius,	31	44	2	6 $\frac{14}{15}$
Ryghte	Virgo, Libra,	30	10	2	0 $\frac{10}{15}$
The summe of the partes.		180	0	12	0

## A table for 20. degrees of latitude.

Ascension	The 12 Signes.	Partes of the Equin.		Partes of tyme.	
		Degrees	Minutes.	Howers.	Minutes.
Crooked	Aries, Pisces,	23	39	1	34 $\frac{9}{15}$
Crooked	Taurus, Aquarius,	26	27	1	45 $\frac{12}{15}$
Ryghte	Gemini, Capricornus	30	48	2	3 $\frac{3}{15}$
Ryghte	Cancer, Sagittarius,	33	36	2	14 $\frac{6}{15}$
Ryghte	Leo, Scorpius,	33	21	2	13 $\frac{6}{15}$
Ryghte	Virgo, Libra,	32	9	2	8 $\frac{9}{15}$
The summe of the partes.		180	0	12	0

## A table for 29. degrees of latitude.

Ascension	The 12 Signes.	Partes of the Equin.		Partes of tyme.	
		Degrees	Minutes.	Howers.	Minutes.
Crooked	Aries, Pisces,	21	25	1	25 $\frac{10}{15}$
Crooked	Taurus, Aquarius,	24	37	1	38 $\frac{7}{15}$
Ryghte	Gemini, Capricornus	30	1	2	0 $\frac{1}{15}$
Ryghte	Cancer, Sagittarius,	34	23	2	17 $\frac{8}{15}$
Ryghte	Leo, Scorpius,	35	11	2	20 $\frac{11}{15}$
Ryghte	Virgo, Libra,	34	23	2	17 $\frac{8}{15}$
The summe of the partes		180	0	12	0

## A table for 30 degrees of latitude.

Ascension	The 12 Signes.	Partes of the Equin.		Partes of tyme.	
		Degrees.	Minutes.	Howers.	Minutes.
Crooked	Aries, Pisces,	21	9	1	24 $\frac{9}{15}$
Crooked	Taurus, Aquarius,	24	23	1	37 $\frac{8}{15}$
Crooked	Gemini, Capricornus	29	56	1	59 $\frac{11}{15}$
Ryghte	Cancer, Sagittarius,	34	28	2	17 $\frac{13}{15}$
Ryghte	Leo, Scorpius,	35	25	2	21 $\frac{8}{15}$
Ryghte	Virgo, Libra,	34	39	2	18 $\frac{9}{15}$
The summe of the partes.		180	0	12	0

## A table for 50. degrees of latitude.

Ascension	The 12 Signes.	Partes of the Equin.		Partes of tyme.	
		Degrees.	Minutes.	Howers.	Minutes.
Crooked	Aries, Pisces,	13	52	0	55 $\frac{7}{15}$
Crooked	Taurus, Aquarius,	17	55	1	11 $\frac{10}{15}$
Crooked	Gemini, Capricornus	27	0	1	48
Ryghte	Cancer, Sagittarius,	37	24	2	29 $\frac{5}{15}$
Ryghte	Leo, Scorpius,	41	53	2	47 $\frac{8}{15}$
Ryghte	Virgo, Libra,	41	56	2	47 $\frac{11}{15}$
The summe of the partes.		180	0	12	0

## A table for 60. degrees of latitude.

Ascension	The 12 Signes.	Partes of the Equin.		Partes of tyme.	
		Degrees	Minutes.	Howers.	Minutes.
Crooked	Aries, Pisces,	7	16	0	29 $\frac{1}{15}$
Crooked	Taurus, Aquarius,	10	56	0	43 $\frac{11}{15}$
Crooked	Gemini, Capricornus	22	56	1	31 $\frac{11}{15}$
Ryghte	Cancer, Sagittarius,	41	28	2	45 $\frac{13}{15}$
Ryghte	Leo, Scorpius,	48	52	3	15 $\frac{7}{15}$
Ryghte	Virgo, Libra,	48	32	3	14 $\frac{2}{15}$
The summe of the partes		180	0	12	0

A table for 66 degrees and  $\frac{1}{2}$  of latitude.

Ascension	The 12 Signes.	Partes of the Equin.		Partes of tyme.	
		Degrees.	Minutes.	Howers.	Minutes.
Sudden	Aries, Pisces,	0	0	0	0
Sudden	Taurus, Aquarius,	0	0	0	0
Sudden	Gemini, Capricornus	0	0	0	0
Ryghte	Cancer, Sagittarius,	64	22	4	17 $\frac{7}{15}$
Ryghte	Leo, Scorpius,	59	49	3	59 $\frac{4}{15}$
Ryghte	Virgo, Libra,	55	49	3	43 $\frac{4}{15}$
The summe of the partes.		180	0	12	0

Scholar. Sir I thanke you moste hartely for these tables, for I haue not seene the lyke of them before: and theyr ordre is so easye, that I neede no greate healpe in the vnderstandinge of them: For as in the tytyle of eche of them is sette the degree of the latitude of the Region for whyche the table is calculate, so in the fyrste columnne is sette the differences of the ascensions in name, and in the seconde columnne are the names of the Signes, whiche haue those diuers Ascensions, eche rowe contayning two Signes, whereby they differ from the ryght Sphere, for in it 4 Signes agree in one quantitie of ascension, wher as in all these

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Ob.

The firste  
rule of Ob-  
lique Ascen-  
tion.

Oblique spheres, only twoo signes doo agree in lykenes of ascension. And in eche of them are there sette in the thirde columnne, the degrees of Ascension, and minutes after them, whiche appertayne to euerye signe: and in the fourthe Columnne are the partes of tyme, agreeynge to those partes of the Equinoctiall circle: by whiche it may appeare not onely howe manye degrees and minutes those Signes occupye in their Ascension, but also howe manye howers or minutes doo answere to the same. And in eche table is sette the full quantitie of halfe a daye, and also of halfe the Zodiake, whiche is the full summe by addition of all the other percelles ouer them: whereby I perceauie it to bee true, that eche halfe of the Equinoctiall dooth equallye ascende wyth eche halfe of the Zodiake.

Master. Beginninge the halues of them bothe at the Equinoctiall pointes, in Aries and Libra, it is most true: but not so yf you begin at the Tropike pointes, or in anye other partes of theym: for yf you begynne at anye of the northerlye Signes betweene Aries and Libra, and so reckon 6 signes togyther, those Sygnes shall haue a ryghte Ascension: for wyth them shall ascende a greater portion of the Equinoctiall. But if you doo reckon syxe Signes and begynne that accompte betweene Libra and Aries, in the southe parte of the Zodiake, then doo those syxe signes ascende crookedlye: for as muche as the portion of the Equinoctiall that ryseth with them, is lesse then halfe of it.

Scholar. For prooffe thereof I take the table of tenne degrees of latitude, and I begynne with Taurus, and so doo I reckon syxe Signes, Taurus, Gemini, Cancer, Leo, Virgo and Libra, vnto which Signes these syxe numbres answere as they be here set, accompting one numbres twise, that

Degrees	Minutes.
28	14
31	31
32	53
31	34
29	57
29	57
184	6

that is fyrst for Virgo, and then for Libra, and so the whole summe of partes of the Equinoctiall is 184 degrees and 6 minutes: that is 4 degrees and 6 minutes more then halfe: wherefore those signes do ascende right. And so I perceave it wyll be in the other lyke woorkes, if I doo begynne wyth anye Signe in that northe halfe of the Zodiake, for see-ynge Aries hath the leaste of all other Ascensions, if I take anye other Signe, and omytte hym, I shall haue a greater noumbré then the halfe of the Equinoctiall circle. But nowe contrarye wayes if I begynne wyth anye of the southe Signes, and so reckon syxe continuall Sygnes, theyr Ascension you saye will bee an Oblyque ascension, bycause theyr degrees wyll bee more in noumbré then the degrees of the Equinoctiall circle: for example I take my beginnynge at Sagittarius, and so reckon forthe directelye syxe Signes, that is Sagittarius, Capricornus, Aquarius, Pisces, Aries and Taurus. and for them I take the numbres of their Ascensions, and set them downe as here you se: so that by addition they doo make 172 degrees, and 34 minutes: that is lesse then the halfe circle by seuen degrees, and 26 mynutes. wherefore it muste needes bee, that those Signes doo ascende crookedlye.

Deg.	Min.
32	53
31	32
28	14
25	51
25	51
28	14
172	34

Master. And so muste it followe where so euer you begynne after Libra in that southe halfe of the Zodiake: for so muche as you omytte the ascension of Libra, beeynge 29 degrees and 57 minutes, and in steed of it you take the ascension of Aries, whiche is but 25 degrees and 51 minutes.

Scholar. Thys reason doothe appeare manyfeste ynoughe: and that not only in this table, but also in al the other, saue that in the laste table I see a straunge dysagreemente frome all the other, for in these syxe Signes,

T.ij.

Aries

Aries, Taurus, Gemini, Capricornus, Aquarius & Pisces; there is set no numbres of degrees or minutes for their ascension, but only cyphers, whiche thyng is straunge to me, for thereby may it be coniectured, that those 6 Signes haue none Ascension at all: and yet I am sure that the fyrste three of them doo ascende not onely in that Climate, but also in all other Climates be north that latitude euen to the northe Pole.

Master. A lyttle mistakinge dooth disturbe your mynde muche, but yf you doo place the sphere in the Horizonte, in suche sorte, that the northe Pole be 66 degrees and halfe aboue the Horizonte, and then tourne the fyrste degree of Aries, to the easte Horizonte readye to ascende, and afterwarde yf you tourne the Globe towarde the weste, but by the quantitie of halfe one degree in the Equinoctiall, you shall perceauie that all those sixe Signes whyche lye from the wynter Tropyke vnto the Sommer Tropike, that is to saye, Capricornus, Aquarius, Pisces, Aries, Taurus, and Gemini, wyll ascende sodainlye in one momente all 6 at ones: so that for their ascension there canne be assigned no degree of the Equinoctiall, nother anye sensible parte of tyme, syth it is doone in a momente of tyme, and therefore muste I putte no degree for their Ascension, nother yet anye tyme. And bycause I thoughte no lesse but that this woulde seeme some thyng straunge vnto you, therefore haue I not touched anye thinge of the other Ascensions for these Climates that bee betweene the Tropike of Cancer and the Pole, beyng adured that they woulde seeme to you muche more straunge, then thys doothe. but hereafter yf I perceauie that you trauayle well in thys first Introduction, I wyll instructe you more largelye in all that shall bee needefulle for you: and in the meane ceason I wyll prosecute the rules of these Ascensions in the Oblyque Spheres, as I dydde begynne.

Wher

wherefore you shall note, that althoughe eche halfe of the Zodiake doo agree in ascension with eche halfe of the Equinoctiall, yet the partes of those halues, I meane the severall signes, and their distincte portions doo not so agree, but are ether more or lesse.

Scholar. So I remembre doth Iohn de sacro Bosco affirm: for (saith hee) in that halfe of the Zodiake, which is betweene the beginninge of Aries, and the eande of Virgo, alwaies the portion of the Zodiake whiche riseth, is greater then the like halfe of the Equinoctiall: and yet those halues doo rise together.

Iohn de sacro Bosco  
his rules examined.

Master. This he speaketh of the Oblique sphere.

Scholar. So dooth he in deede.

Master. Propounde you an example, that I maye knowe howe you do vnderstande it.

Scholar. I take an example out of the table of 50 degrees of latitude, and for the fyrste fyue Signes I sette the quantities of their ascensions, as heere is seene, whiche by Addition doo make 138 degrees and foure minutes. so dooth there wante of 150 degrees, whiche are the fulle degrees for fyue signes, 11 degrees and 56 minutes. that arke therefore of the Equinoctiall is lesser then the matche arke of the Zodiake: but nowe there resteth in that halfe of the equinoctiall 41 degrees and 56 minutes, whiche is the iuste ascensio of Virgo, in that latitude, and so those both halues doo ascend ioyntly together.

13	52
17	55
27	0
37	24
41	53
138	4

Master. Prooue the lyke woorke in the table of 10 degrees of latitude.

Scholar. For the fyrste 5 signes Aries, Taurus Gemini, Cancer and Leo, I set their ascensions thus. And by addition I fynde that theyr whole summe for all that arkes ascension is 150 degrees and three mynutes. that is three mynutes more thenne the degrees of fyue Sygnes,

25	51
28	14
31	31
32	53
31	34
150	3

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whiche

whiche is 5 times 30. And so is this example against the rule, for here the greater portion is of the Equinoctiall.

Master. Proue yet againe in the table of one degree of latitude.

Scholar. The ascensions of the fyrste 5 signes in that latitude, are these: and make in one total summe, 151 degrees, and 54 minutes: that is 1 degree, and 54 minutes more then the like arke of the 5 signes in the Zodiake, whiche containeth but onely 150 degrees. And so is this example also against the rule.

27	42
29	44
32	8
32	16
30	4
151	54

Master. So you haue two examples contrary to that rule.

Scholar. It can not be denied.

Master. Then is that no certain rule.

Scholar. It seemeth so.

Master. In deede it is true onely about 13 degrees of latitude. for in all climates and paralleles vnder 13 degrees of latitude, the equinoctiall maketh greatest nombre of degrees in his arke. so that Iohn de sacro Bosco his woordes maye not be accompted true generally (as they sounde) but particularly betwene 13 degrees of latitude, and 66 and an halfe: and so is it to be sayde of diuers other of his rules.

Scholar. Is there the lyke diuersitye beyonde 66 degrees and a halfe northward?

Master. There is more diuersitie, but such and so straung as I will not at this time trouble your head withall, but wyll appoint a more conuenient place for it.

Scholar. Then I beseeke you to prosecute the rest of Iohn de sacro Bosco his rules, touchinge ascensions.

Master. Repete you the rules.

Scholar. His nexte rule is: that in the other halfe of the Zodiake, from the beginning of Libra, to the eande of Pisces euermore there riseth a greater parte of the Equinoctial then of the Zodiake, and yet bothe those halues doo ryse fully together.

Master

Master. Prooue it by some examples.

Scholar. In the latitude of 30 degrees I take Libra onely, and fynde against it 34 degrees and 39 minutes: so is there 4 degrees and 39 minutes more of the equinoctiall then of the Zodiake agreablye to the rule. Also in the table of 60 degrees with Libra, there doth ascende in the equinoctiall 48 degrees and 32 minutes, that is to saye 18 degrees and 32 minutes more then the 30 degrees of Libra.

Master. Assaye the lyke in the latitudes of one degree, and of 10 degrees.

Scholar. In the latitude of 10 degrees, the signe of Libra hath for his ascension 29 degrees, and 57 minutes of the Equinoctiall, that is 3 minutes lesse then the degrees of the Zodiake, and so is that contrarye to the sayde rule.

Master. Nowe proue the other.

Scholar. In that parallele where the Pole is but one degree hyghe, the Signe of Libra ascendeth with 28 degrees and 6 minutes of the Equinoctiall, so is that arke of the Equinoctiall lesser then the degrees of the sayde signe of Libra, by 1. degree and 65 minutes, and yet by the rule it shuld be greater. wherfore I maye perceauē, that this rule dooth not serue for all Latitudes, but for certaine of them. And as I thinke, not for anye aboue 10 degrees, althoughe (as you sayd) the other exception did extend to 13 degrees of latitude.

Master. What causeth you to thinke so?

Scholar. The table calculate by you for 11 degrees of latitude, where I see 30 degrees, and 10 minutes of the Equinoctiall, assigned for the ascension of the signe of Libra, and there is the portion of the Equinoctiall greater by 10 minutes then the portion of the Zodiake.

Master. In deede for whole signes this exception extendeth not aboue 10 degrees of latitude, and no more doothe the other former exception, but yet in partes of signes it extendeth in them both to 13 degrees, as herafter you shall perceauē more at large. but now go forth to the nexte rule.

T.iiij. Scholar

The fourth rule. Scholar. The fourth rule is this: that those arkes which succede after Aries vnto the eande of Virgo in the Oblique sphere, do abate their ascensions in comparison to the ascensions that they haue in the Right sphere: namely seeyng lesse dooth rise of the Equinoctiall.

## A TABLE OF ASCENSIONS

showinge all diuersities of them, vnto the Polare circle, peculiare for cuery seuerall Signe.

Degrees of latitude.	Aries Pisces			Taurus Aquarius		Gemini Capricor		Cancer Sagittari.		Leo Scorpius.		Virgo Libra	
	Deg.	Min.		Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.
0	27	54		29	54	32	12	32	12	29	54	27	54
1	27	42		29	44	32	8	32	16	30	4	28	6
2	27	30		29	34	32	4	32	20	30	14	28	18
3	27	17		29	25	32	0	32	24	30	23	28	31
5	26	53		29	4	31	52	32	32	30	44	28	55
8	26	16		28	34	31	40	32	44	31	14	29	32
10	25	51		28	14	31	31	32	53	31	34	29	57
11	25	38		28	4	31	27	31	57	31	44	30	10
15	24	46		27	23	31	10	33	14	32	25	31	2
20	23	39		26	27	30	48	33	36	33	21	32	9
25	22	27		25	27	30	24	34	0	34	21	33	21
30	21	9		24	23	29	56	34	28	35	25	34	39
35	19	43		23	9	29	24	35	0	36	39	36	5
40	18	4		21	45	28	47	35	37	38	3	37	44
45	16	10		20	3	28	1	36	23	39	45	39	38
50	13	52		17	55	27	0	37	24	41	53	41	56
55	11	1		15	5	25	31	38	53	44	43	44	47
60	7	16		10	56	22	56	41	28	48	52	48	32
65	2	4		3	44	15	20	49	2	56	5	53	45
66 $\frac{1}{2}$	0	0		0	0	0	0	64	22	59	49	55	49

Master. For tryall of this rule I haue sette forth here a table contayninge all the diuersities (though not all the seuerall degrees of latitude) that happen in anye Climate vnder 67 degrees of latitude, that is vnto the Polare circle. So that by thys table you maye examine all the rules bothe of Iohn de Sacro Bosco, and also of others. Nowe therefore examine those arkes that followe Aries, and so abate their ascensions, as your rule saythe, frome Aries, vnto the eande of Virgo.

Scholar. Firste for Aries it selfe: I see that it abateth in this table from 27 degrees and 54 minutes vnto nothinge. And Taurus abateth also frome 29 degrees and 54 minutes vnto nothinge. Lykewise Gemini abateth from 32 degrees and 12 minutes vnto nothinge. But contrary waies, Cancer, Leo, and Virgo, do not abate, but increase the quantities of their Ascensions. so that in the three firste Signes onely (that is Aries, Taurus and Gemini) that rule is true, and in the other three Signes, Cancer, Leo and Virgo, it appeareth vnterly to be false.

Master. Yet in one manner of consideration those words maye be true as he hath spoken them, though not so largely as the woordes do sound: for it appeareth that your author doth accompt the beginning of those arkes (whereof he speaketh) not from diuers and seuerall pointes, but from one common beginning, which is the fyrst degree of Aries, and in that sence his rule is true. for prooffe whereof here is two other tables sette forth, in whiche is declared the quantities of the Ascensions of the twelue Signes, but not in such sorte as it was in the table nexte before, for there euerye arke of the seuerall Signes did take his beginnunge at the fyrst degree of the same Signe. but in these twoo tables the arke of ascension is accompted from the fyrst degree of Aries, as from the common beginning, and eandeth at the laste degree of euery seuerall Signe. And now by this fyrst table if you examine þ former rule you shal find it to be true.

Scholar

# THE FOVRTH TREATISE OF A TABLE FOR THE DIVERSITIES

of Ascensions for the firste 6 Signes from the Equi-  
noctiall to the Polare circle, accomptinge the  
beginninge of euery arke, from the firste  
degree of Aries.

The elevation of the Pole.	Aries		Taurus		Gemini		Cancer		Leo		Virgo	
	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.
0	27	54	57	48	90	0	122	12	152	6	180	0
1	27	42	57	26	89	34	121	50	151	54	180	0
2	27	30	57	4	89	8	121	28	151	42	180	0
3	27	17	56	42	88	42	121	6	151	29	180	0
4	27	5	56	20	88	15	120	44	151	17	180	0
5	26	53	55	57	87	49	120	21	151	5	180	0
8	26	16	54	50	86	30	119	14	150	28	180	0
10	25	51	54	5	85	36	118	29	150	3	180	0
11	25	38	53	42	85	9	118	6	149	50	180	0
15	24	46	52	9	83	19	116	33	148	58	180	0
20	23	39	50	6	80	54	114	30	147	51	180	0
25	22	27	47	54	78	18	112	18	146	39	180	0
30	21	9	45	32	75	28	109	56	145	21	180	0
35	19	43	42	52	72	16	107	16	143	55	180	0
40	18	4	39	49	68	36	104	13	142	16	180	0
45	16	10	36	13	64	14	100	37	140	22	180	0
50	13	52	31	47	58	47	96	11	138	4	180	0
55	11	1	26	6	51	37	90	30	135	13	180	0
60	7	16	18	12	41	8	82	36	131	28	180	0
65	2	4	5	48	21	8	70	10	126	15	180	0
66 1/2	0	0	0	0	0	0	64	22	124	11	180	0

Scholar. I perceauē that the fyrste line of numbres vnder  
the signes, against the cypher 0, doth represent the quanti-  
ties of the Ascensions in the righte sphere, and all the other  
lynnes doo declare the speciall quantities of seuerall ascensi-  
ons

## A TABLE OF THE DIVERSITIES

of Ascensions for the 6 southerlye Signes, ac-  
comptinge the beginninge of those  
Ascensions, from Aries firste  
degree.

Degrees of latitude.	Libra		Scorpius.		Sagittari.		Capricor		Aquarius		Pisces	
	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.	Deg.	Min.
0	207	54	237	48	270	0	302	12	332	6	360	0
1	208	6	238	10	270	26	302	34	332	18	360	0
2	208	18	238	32	270	52	302	56	332	30	360	0
3	208	31	238	54	271	18	303	18	332	43	360	0
4	208	43	239	16	271	45	303	40	332	55	360	0
5	208	55	239	39	272	11	304	3	333	7	360	0
8	209	32	240	46	273	30	305	10	333	44	360	0
10	209	57	241	31	274	24	305	55	334	9	360	0
11	210	10	241	54	274	51	306	18	334	22	360	0
15	211	2	243	27	276	41	307	51	335	14	360	0
20	212	9	245	30	279	6	309	54	336	21	360	0
25	213	21	247	42	281	42	312	6	337	33	360	0
30	214	39	250	4	284	32	314	28	338	51	360	0
35	216	5	252	44	287	44	317	8	340	17	360	0
40	217	44	255	47	291	24	320	11	341	56	360	0
45	219	38	259	23	295	46	323	47	343	59	360	0
50	221	56	263	49	301	13	328	13	346	8	360	0
55	224	47	269	30	308	23	333	54	348	59	360	0
60	228	32	277	24	318	52	341	48	352	44	360	0
65	233	45	289	50	338	52	354	12	357	56	360	0
66 $\frac{1}{2}$	235	48	295	36	360	0	0	0	0	0	0	0

ons in eche of those distinct latitudes, which be noted in the  
first columnne in both tables. Therefore now I maye perceave  
according to þ former rule, þ the greatest nūbre of any down  
right column is þ highest nūbre in þ hed of þ same column,  
so that

so that it may truely bee saide (as appeareth in this first table) that in eche Oblique sphere the ascensions of the arkes from Aries vnto the eand of Virgo, do abate still and waxe lesse and lesse, in respecte to their ascensions that they haue in the Right sphere.

Thre signi-  
fications of  
Ascension.

Master. Thus you see, howe there may be accompted diuers formes of ascensions: firste (as I sayde at the beginning of that definition) it maye signifie that degree certenlye of the Equinoctiall, whiche dooth ascende with anye signe or parte thereof: as for example. in the latitude of 50 degrees, the laste degree of Aries hath for his ascension the 13 degree and 52 minute of the Equinoctiall, as by the firste of these twoo tables it dooth appeare: and in the same table it appeareth, that the laste degree of Taurus hath for his ascension in the same latitude the 31 degree and 47 minut of the Equinoctiall. And in the seconde signification, the ascension of Aries whole signe is that whole arke of 13 degrees and 52 minutes, and so the whole arke from the beginning of Aries, to the eande of Taurus, hath for his ascension that whole arke of 31 degrees, and 47 minutes of the Equinoctiall. And in this signification dooth Iohn de sacro Bosco vse the name of Ascension, and in this sense his rules be true: accordinge to whiche sense I haue drawen to you certaine tables: the firste for the ascensions of the twelue Signes in the right Sphere: the second, for the ascension of the Signes in 52 degrees of latitude: the thirde and fourthe are these twoo tables last before, which for diuers latitudes doo declare the quantities of the Ascensions of al arkes of whole signes accompted from the beginning of Aries. The thyrde signification of ascensions is the quantitie of that arke of the Equinoctiall whiche ascendeth with anye certaine arke of the Zodiacke: as for example. that arke of the equinoctiall that ascendeth with any signe seuerally taken, is called the ascension of that signe. So haue you for euery signe certain seuerall arkes of ascension assigned, and set forthe here in diuers tables, according

cordinge to diuers eleuations of the Pole. And in this signification must it be vnderstande, when it is sayde that any signe hath a Right ascension or an Oblique ascension, for if the arke of the Equinoctiall that riseth with that signe, bee greater then 30 degrees, then hath that signe a Right ascension: and if the arke of the Equinoctiall be lesser then 30 degrees, then is that ascension called an Oblique ascension: but if the sayd arke of the Equinoctiall be iuste 30 degrees, then is it a Meane or Equall ascension.

A Ryghte  
ascension.

An Oblique  
ascension.

A meane  
ascension.

Scholar. Nowe doo I better vnderstande the vse of these names then I dyd before: and also I perceauē howe the names of greater and lesser portion are to be referred, not of eche greater to eche lesser, for so the ascension of Taurus myghte be accompted greater then the ascension of Aries, and lesser then the ascension of Gemini, in all climates without the Polare circle. And so one ascension might be both greater and lesser, and therefore bothe ryghte and crooked, whiche is an absurditie.

Master. Thus hath ordre taught you, that wherof you wer in doubt and manifestly approued that that seemed very obscure. Now therefore returne to your author again. And repete his other rules as he doth teache them.

Scholar. His fiste rule is this: The arkes whiche followe Libra, vnto the eande of Pisces, in an Oblique sphere, doo increase their ascensions aboue the ascensions that they haue in the Right sphere in as much as the portion of the Equinoctiall is augmented. And the increase of those ascensions is agreeable in rate to the decrease of those other ascensions whiche succede from Aries to Libra.

The fiste  
rule.

Master. This rule muste be vnderstande of ascensions in the seconde signification: and that may you trye by the later of those twoo tables which I gaue you laste.

Scholar. It appeareth so in deed. for Libra increaseth from 207 degrees and 54 minutes, vnto 235 degrees & 48 minutes. And Scorpio frō 237 degrees & 48 minuts, vnto 295 degrees

V.i.

and

and 36 minutes. likewise Sagittarius from 270 degrees vnto 360 degrees. So dooth it appeare, that Libra dooth increase betweene the Equinoctiall and the Polare circle, 27 degrees, and 54 minutes. And Scorpio increaseth 57 degrees and 50 minutes. Also Sagittarius augmenteth by 90 degrees. And now contrarye waies, Aries doth abate from 27 degrees and 54 minutes to nothinge. Taurus diminisheth from 57 degrees and 48 minutes vnto nothinge also. And Gemini abateth from 90 to 0: so dooth these three in decreasse agree with the other in increase exactly.

The sixte  
rule.

Master. And so maye you iudge of the other three couples. And therefore sayth your author, that hereby it is manifest, that two equall arkes lying one against the other, and in an Oblique sphere, haue their ascensions ioynntlye taken togyther equall wyth the Ascensions of the same arkes in a Ryghte Sphere, ioynntlye taken also: for althoughe those arkes bee vnequall togyther, yet as muche as the one abateth on the one syde, so muche the other increaseth on the other syde. and so bothe arkes in the Ryght sphere are equall to bothe those arkes in any Oblique sphere.

Scholar. But I praye you, in what signification of ascension is that rule to be vnderstande?

Master. In anye of those twoo which be referred to arkes: for the fyrste can haue no place here, bicause it signifieth the ascension of one pointe only, and not of any arke as the other twoo do, and as this rule doth importe.

Scholar. Then may I proue by examples in both sortes of tables. And firste to beginne with those tables that accompt the whole arkes from the beginning of Aries, I fynd the ascension of Aries in the head of the table, that is in the right sphere, to be 27 degrees & 54 minutes, & the ascension of Libra (which is against it) 207 degrees & 54 minutes. which both ioyned togyther, make 235 degrees & 48 minutes. Now to proue þe like in an Oblique Sphere, I take the latitude of 40 degrees, and

27	54
207	54
235	48

and there I fynde for Aries his ascension 19 degrees and 4 minutes: and for Libra I fynde in the seconde table 217 degrees and 44 minutes: whiche both beyng added together, do make 235 degrees and 48 minutes, that is precisely equall with the former ascensions in the right sphere. Also in the elevation of 60 degrees I trye the like, where Aries hath 7 degrees and 16 minutes, and Libra hath 228 degrees and 32 minutes, which by additiō amount to the same sum as before.

Master. Attempt the lyke in the other tables.

Scholar. I take the arke of Aries ascension as before 27 degrees and 54 minutes: and the ascension of Libra (accomp-tyng only the arke of it from his owne beginninge) in lyke sorte 27 degrees and 54 minutes: so that both ioyned together, make 55 degrees and 48 minutes. Then in the latitude of 55 degrees, I fynde for Aries 11 degrees and one minute: and for Libra, 44 degrees and 47 minutes. and by additiō I find that they make the same numbre as before.

Master. Make prooffe in some other arke.

Scholar. I take fyrste the arke from the beginning of Leo, to the eande of the same Signe, and fynd it to bee 29 degrees and 54 minutes in the ryght sphere: and so for the Ascensio of the Signe of Aquarius, beyng equall to it, and agaynste it in the Zodiake, I fynde the lyke noumbre, whiche make by addition 59 degrees and 48 minutes. Then in the latitude of 30 degrees I trye the lyke, and fynde for Leo 35 degrees and 25 minutes: and for Aquarius there dooth rise 24 degrees and 23 minutes: which make also together the same sum of 59 degrees and 48 minutes. So in both those significations, whether I accompte feuerall arkes from feuerall beginnings, or generall arks from one generall beginning, the rule is founde true. Now resteth but one rule more of ascensio in this author to be discuffed, and that is this: that in an oblique sphere echē 2 arkes of the Zodiake being equal and equally distaunt from any one of the Equinoctiall pointes, shall haue equall ascensions.

18	4
217	44
235	48

7	16
228	32
235	48

27	54
27	54
55	48

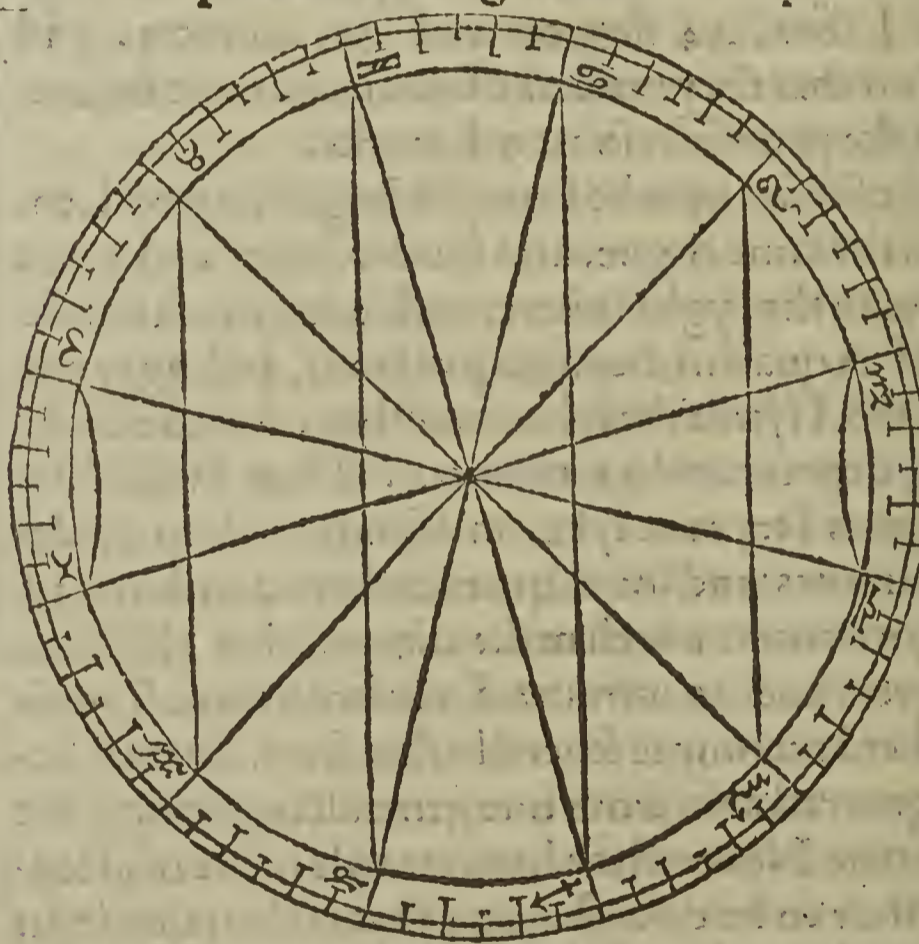
11	1
44	47
55	48

29	54
29	54
59	48

35	25
24	23
59	48

The 7 rule

Master. This rule is partly a greeable with the laste rule, and partly feuerall, in as much as euery contrarye arke is lyke distaunte from the one Equinoctiall pointe, as the fyrste arke is from the other Equinoctiall pointe. thys rule dooth agree (after a sorte thoughe not proprely) wyth the other laste before: but consideringe that Aries and Pises as whole signes haue lyke arkes, and are equallye dystaunt from one Equinoctiall pointe, thoughe in backe ordre: for the eande of Aries is iuste equall in distaunce from the precise Equinoctioll po inte, as the beginninge of Pises is from the same. And in this pointe these Signes haue thys seuenth rule as a speciall rule for theym and their Ascensions. Lykewaies Taurus compared wyth Aquarius, Gemini with Capricorne, Cancer with Sagittarius, Leo with Scorpius, and Virgo with Libra, as this figure dooth



shew exactly, althoughe in the same I haue marked also the contrary signes that it might be a common figure for bothe those rules, so that euery feuerall sign hath 2 matches, with which it may be conferred, one of theym righte

againste him. and that comparison is in the 6 rule: and the other lesse distaunt, & ther conference belongeth to this 7 rule.

Scho-

Scholar. As this figure doth teache me what signes may be conferred together, so the tables before written doo declare the quantities of their ascensions in those seuerall latitudes: and the true meaning of bothe those rules, as well as of other, touchinge ascensions.

Master. But this muste you farther knowe, that those rules doo speake generallye of anye twoo arkes, whether they bee greater or lesser then a Signe, and doo not meane of Signes onlye.

Scholar. That muste needes follow ordrelly: for if Aries bee equall in ascension with Pisces, and Taurus equall in risinge with Aquarius, then ioyntly Aries and Taurus must needes be of one quantitie in ascension with Aquarius and Pisces, by composition of proportions, as is taughte in Geometrye and Arithmetike also.

Master. Lykewaile (by resolution of propositions) if all Aries be like in ascension with all Pisces, then the first degree of Aries shall ascende equallye with the laste degree of Pisces: and the 20 degree of Aries, wyth the 10 degree of Pisces: & in lyke manner of eche other degree equally distaunte from the Equinoctiall pointes: and so lykewaies of euery minute: for these rules of equalitie or inequalitye of Ascensions of arkes, doo serue as well for the arkes of degrees and mynutes, as for the arkes of whole Signes, or of greater quantities. Also this rule is general, that all arkes that ascende rightly, do descende crookedly, be they great or small: and contrarye wayes, what arke so euer ascendeth crookedlye, doth descende righte: whereby it commeth to passe, that alwaies the one signe counteruailynge with his contrary, there is euermore one halfe of the Zodiake aboue the Horizonte, as well as there is one halfe of the Equinoctiall aboue the same. so that when so euer anye degree of the Zodiake doth set in the weste, the contrarye degree dooth rise in the east. Of this it foloweth, that in the longeste daye in the yeare there dooth rise but syxe Sygnes, and in the

shortest daye there riseth as manye signes.

Howers  
vnequall.

Scholar. Thereof it maye seeme to come to passe, that in aunciente tyme the day and the nyghte were euermore diuided into 12 equall partes, (how longe or how short so euer they were) and those partes were called Vnequall howers, of whiche yet manye men doo write, and doo call them howers of the Planets: but as I iudg by the ordre of the ascensions, euerye signe hath not equall Ascension, nor equall time in risynge, therefore may those howers be well called Vnequall, which depend of the motion of the Zodiake, beeyng in it selfe vnequall in his Ascension.

Master. It is thought of some men to be a more apte reason to call those howers vnequall, bicause not only the sommer howers are vnequall to the winter howers, but also the daye howers vnequall to the night howers.

Naturall  
howers.

Scholar. Iohn de sacro Bosco doth call them naturall howers, and defineth them to be the measure of the tyme, in whiche halfe a signe dooth ascend.

Master. As the 6 signes that rise in the daye or in the nyghte keepe not one vniforme equalitye in their rysynge, so doth the Ascensions of the halfe signes differ more vnequallye: and by that meanes the howers of the daye can not be equall together, nother yet the howers of the nyght may be called equall together: wherefore other you must not allowe that definition, or els you must not parte the daye and the nyght into equall partes.

Scholar. I knowe not what to saye to this, for nother can I defende that definition, nother yet can I improue that partition.

Equall hou  
res called  
Equinoctial  
howers.

Master. Those howers haue beene the occasion of much contention, and therefore were they wittilye reiected oute of the daylye vse, wherein they were ones common, and were lefte only to learned men, for learned vses; and in their steed other howers more certaine and equall were diuised, whiche doo diuide the naturall day into 24 equall partes, and these keepe

keepe one iuste quantitie, how so euer the Artificiall day do varye his quantitie.

Scholar. This I knowe well: but yet touchynge the fyrste howers, called the Planet howers, I woulde gladlye vnderstande some example for their exacte diuersitie in some one daye.

Master. You shall haue anone one generall table for many dayes, namely for euerye syxte daye in the yeare nighthe hande, and that table shall suffice for the whole yeare: and yt shall be calculate accordyng to that exact forme of distinction of howers, by halfe Signes of the Zodiake: but in the meane ceason, bicause you shall not be ignorant of the vulgare forme of vnequall howers, I haue heere sette forth an ordrelie partition of them, accordyng to the lengthe of euerye daye or nyghte in the yeare, by increase frome 12 minutes to 12 minutes, for eche day or nyghte, from the shortest daye, or nyghte of 1. minute of length, vnto the longest daye or nyghte of 24 howers.

Scholar. But what if the longest daye be not so longe, as it is not with vs in Englande?

Master. The table doothe serue for all places where the dayes be of shorter lengthe: as by the ouermoste title and that fyrste colunne on the lefte hande you may perceaue.

Scholar. I was to negligente, that I did not consider that, for as it maye serue for that daye in the yeare whiche is but 16 howers longe, (thoughe the longest daye bee longer) so maye it serue for that place where the longest daye is but 16 howers in quantitie.

Master. Yea and for the myddle of the earthe vnder the Equinoctial, where the longest day is but 12 howers, so that it serueth from the Equinoctiall circle, vnto the Polare circle, and for all Climates that be betweene them, as by the howers in the firste colunne you may perceaue. So that if you will knowe the quantitie of anye hower vnequall, or hower of the Planetes, after this forme: fyrst you muste knowe the

The vse of  
the table.

# A TABLE FOR THE HOURES OF Planetes after the common forme.

Minutes.	0		12		24		36		48	
Hour.	Hour.	Minu.	Hour.	Minu.	Hour.	Minu.	Hour.	Minu.	Hour.	Minu.
0	0	0	0	1	0	2	0	3	0	4
1	0	5	0	6	0	7	0	8	0	9
2	0	10	0	11	0	12	0	13	0	14
3	0	15	0	16	0	17	0	18	0	19
4	0	20	0	21	0	22	0	23	0	24
5	0	25	0	26	0	27	0	28	0	29
6	0	30	0	31	0	32	0	33	0	34
7	0	35	0	36	0	37	0	38	0	39
8	0	40	0	41	0	42	0	43	0	44
9	0	45	0	46	0	47	0	48	0	49
10	0	50	0	51	0	52	0	53	0	54
11	0	55	0	56	0	57	0	58	0	59
12	1	0	1	1	1	2	1	3	1	4
13	1	5	1	6	1	7	1	8	1	9
14	1	10	1	11	1	12	1	13	1	14
15	1	15	1	16	1	17	1	18	1	19
16	1	20	1	21	1	22	1	23	1	24
17	1	25	1	26	1	27	1	28	1	29
18	1	30	1	31	1	32	1	33	1	34
19	1	35	1	36	1	37	1	38	1	39
20	1	40	1	41	1	42	1	43	1	44
21	1	45	1	46	1	47	1	48	1	49
22	1	50	1	51	1	52	1	53	1	54
23	1	55	1	56	1	57	1	58	1	59
24	2	0								

iust quant ty of the day artificiall, from sonne risynge to son  
 settinge, and thereby also the quantitie of the nyghte: then  
 shall you seke the houres of their length in the first column,  
 vnder the title of howers: and if the daye or nyght haue any  
 minutes aboue those euen howers, you shall seke them in the  
 highest

highest range of numbres, where they bee set from 12 to 12, and take that nombre of minutes that is nexte in quantitie to your minutes in the day propounded; and in the cōmon angle, againste your howers and vnder your minutes, you shall fynde the iuste quantitie of the minutes that make an hower vnequall, for that daye or nyght: but that must you vnderstande seuerally.

Scholar. I were to grosse headed if I wold make a doubt thereof. And bycause I will declare vnto you how I vnderstande the vse of it, I wyll by an example or twoo make it appeare. When the Artificiall daye is 14 howers longe, and 20 minutes, and the nyghte then is 9 howers longe and 40 minutes of necessitye: I woulde knowe the iuste quantitie of the howers vnequall. Firste therefore, in the fyrste colomne I seeke oute the nombre of the howers, whiche is 14, then in the highest raunge of numbres I seeke the odde minutes, beinge 20, and bicause I fynde no suche nombre there, I take the nexte nombre whiche is 24, and by those 2 numbres in their common angle againste 14 towarde the righte hande, directly vnder the 24 minutes, I fynde 1, 12, whereby I vnderstande, that eche vnequall hower is longer then the equall hower by 12 minutes that daye. and for the nyghte I fynde againste 9 and vnder the nombre of 36 (whiche is nexte vnto 40) the iuste quantitie of eche vnequalle hower of the same nyghte, to bee 0, 48, that is but 48 minutes: and so is the vnequall hower of the nyghte lesse by twelue minutes, then is the equalle hower. And so bothe those howers ioyned together, doo make twoo howers, equall to twoo Equinoctiall or Equall howers. for so muche as the one is to lyttle, the other is to greate. Againe for an other triall, I take the artificiall daye to bee 9 howers and 36 minutes long, and therefore to know the quantitie of an vnequall hower, I seeke against 9, and vnder the 36, wher I fynd 0, 43, which giueth me to vnderstand that the vnequall hower that daye is only 43 minutes in quantity, & the

the nyghte then beyng 15 howers long and 24 minutes, yeldeth his vnequall howers of 1 hower and 17 minutes longe: whereby it is seene also, that so muche is supplied by the one hower as was wantinge in the other. so that euermore one vnequall hower of the day ioined with an vnequal hower of the nyghte, will make two howers equall to two equinoctiall howers.

Howers equall, equinoctial, vulgar and naturall.

Scholar. You meane those common howers which we vse vulgarlye; whiche are called also of some men Naturall howers, takinge that name of the Naturall daye, whiche they diuide into 24 equall partes, (thoughe other men adscribe that name to Vnequal howers) and so of their common vse ar they named Vulgare, lyke as they are called Equinoctiall howers, bycause (as I haue learned) they depende of the resolution of the Equinoctiall: and therefore keepe they one constante quantitie, eche beyng equall with other.

Vnequall howers.

The declaration of the table.

Master. You remembre it well. And as these are taken of the motion of the Equinoctiall, and are nothing els but the space or measure of time wherein 15 degrees of the Equinoctiall do passe the meridiene line, so againe it seemeth to the wisest sorte of men, that the Vnequall howers ought to be gathered by the motion of the Zodiacke, whose seuerall forme of ascension for euery halfe signe, dooth make a seuerall and distinct quantitie of Vnequall howers, and haue no fewer sortes of differences, then there be distincte and seuerall degrees or pointes, at whiche that arke of 15 degrees maye beginne his ascension, as partly in this table folowing it dooth appeare: where you may see in the fyrste colunne on the lefte hande, and in the laste on the right hand, the degrees of the signes set: not euery one seuerally, but only from 6 degrees to 6 degrees, whiche are so mennye as may seeme to suffice for a conuenient distinction of the seuerall diuersities in such hours, namely in that latitude of 52 degrees, for whiche it is calculate. And nexte vnto those degrees in the seconde colunne, and in the laste saue one, are set the names

of

of the 12 Signes in their conuenient ordre, that is to say, in the one parte the 6 Signes whiche be called north Signes, as Aries, Taurus, Gemini, Cancer, Leo, and Virgo: and in the other are set the 6 south Signes, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, & Pisces. And against those signes and degrees are set the quantities of euery hower in the daye for that time, when the Sonne is in any suche degree of those signes. And for the better knowledge of the howers, their names and numbres are set forth in the head of the table: where also is set a distinction by diuersitye of the daye and nighte accordinglye as the Sonne is then in the southe Signes or in the northe signes.

Scholar. I doo perceauē it to bee reasonable, that the first hower of the daye muste be accompted that hower, in whose beginning the Sonne doth rise: so that euery daye the fyrste hower is begonne with the ascension of that degree of anye signe wherein the sonne is. And the first hower of the night is begonne with the ascension of that degree, which is opposite or contrary to the place of the sonne: whiche place is commonly called in latine Nadir Solis, althoughie in deede the one woorde is an Arabike woorde, and not latine. And after that first hower as the other howers of necessitye doo follow in ordre of numbre, so their distinction in quantitie doth follow in this table: and the difference of them is agreeable to the diuersitye of the ascension of eche halfe signe of the Zodiake, as they doo followe in ordre. So that to come to an example, for declaration that I doo vnderstande that table. yf I woulde knowe the quantitie of the vnequall howers, when the sonne is in Aries and in his fyrste degree, I must entre the fyrste parte of the table, where I fynde on the lefte hande the Signes and their degrees: wherefore againste Aries and  $\gamma$  cyphar 0, which betokeneth the very beginning of the signe, I note all the howers as they followe in ordre: whereby I perceauē that the fyrste hower of the day is but 25 minutes of an equall hower in lengthe: the seconde hower

Example.



## ON OF THE VNEQVALL HOWERS

52 degrees.

Howers of the nyghte, for the northe Signes: and of the daye, for the southe Signes.

7		8		9		10		11		12		Signes
1	2	3	4	5	6	7	8	9	10	11	12	
H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	Howres
1 26	1 26	1 26	1 25	1 21	1 11	0 59	0 47	0 37	0 30	0 27	0 25	12
1 26	1 26	1 26	1 24	1 17	1 7	0 54	0 47	0 34	0 33	0 26	0 24	6
1 26	1 27	1 26	1 22	1 13	1 2	0 49	0 39	0 32	0 27	0 25	0 25	12
1 26	1 26	1 24	1 19	1 9	0 57	0 45	0 36	0 4	0 26	0 25	0 25	18
1 27	1 26	1 27	1 15	1 4	0 52	0 41	0 33	0 28	0 25	0 24	0 26	24
1 26	1 25	1 21	1 11	0 59	0 47	0 37	0 30	0 27	0 25	0 25	0 27	m 0
1 26	1 24	1 17	1 7	0 54	0 47	0 34	0 33	0 26	0 24	0 25	0 28	6
1 26	1 22	1 13	1 2	0 49	0 39	0 32	0 27	0 25	0 25	0 26	0 30	12
1 24	1 19	1 9	0 57	0 45	0 3	0 34	0 26	0 25	0 25	0 27	0 32	18
1 27	1 15	1 4	0 52	0 41	0 33	0 28	0 25	0 24	0 26	0 29	0 34	24
1 21	1 11	0 59	0 47	0 37	0 30	0 27	0 25	0 25	0 27	0 30	0 37	4 0
1 17	1 7	0 54	0 47	0 34	0 33	0 26	0 24	0 25	0 28	0 33	0 41	6
1 13	1 2	0 49	0 39	0 32	0 27	0 25	0 25	0 26	0 30	0 36	0 45	12
1 9	0 57	0 45	0 36	0 34	0 26	0 25	0 25	0 27	0 32	0 39	0 49	18
1 4	0 52	0 41	0 33	0 28	0 25	0 24	0 26	0 29	0 34	0 43	0 54	24
0 59	0 47	0 37	0 30	0 27	0 25	0 25	0 27	0 30	0 37	0 47	0 59	yo 0
0 54	0 47	0 34	0 33	0 26	0 24	0 25	0 28	0 33	0 41	0 52	1 4	6
0 49	0 39	0 32	0 27	0 25	0 25	0 26	0 30	0 36	0 45	0 57	1 9	12
0 45	0 36	0 34	0 26	0 25	0 25	0 27	0 32	0 39	0 49	1 2	1 13	18
0 41	0 33	0 28	0 25	0 24	0 26	0 29	0 34	0 43	0 54	1 7	1 17	24
0 3	0 30	0 27	0 25	0 25	0 27	0 30	0 37	0 47	0 59	1 11	1 20	30 0
0 34	0 33	0 26	0 24	0 25	0 28	0 33	0 41	0 52	1 4	1 16	1 23	6
0 32	0 27	0 25	0 25	0 26	0 30	0 36	0 45	0 57	1 9	1 19	1 24	12
0 34	0 26	0 25	0 25	0 27	0 32	0 39	0 49	1 2	1 13	1 22	1 26	18
0 28	0 25	0 24	0 26	0 29	0 34	0 43	0 54	1 7	1 17	1 24	1 26	24
0 27	0 26	0 5	0 27	0 30	0 37	0 47	0 59	1 11	1 20	1 25	1 26	X 0
0 26	0 24	0 25	0 28	0 33	0 41	0 52	1 4	1 16	1 23	1 26	1 27	6
0 25	0 25	0 26	0 30	0 36	0 45	0 57	1 9	1 19	1 24	1 26	1 26	12
0 25	0 25	0 27	0 32	0 39	0 49	1 2	1 13	1 22	1 26	1 27	1 26	18
0 24	0 26	0 20	0 34	0 43	0 54	1 7	1 17	1 24	1 26	1 26	1 26	24
0 25	0 27	0 30	0 37	0 47	0 59	1 11	1 20	1 25	1 26	1 27	1 25	30
H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	H.M.	

is 27 minutes longe: the thirde hower 30 minutes, that is halfe an equall hower iuste: and in the same line goinge forward, the 12 and laste hower of the daye is 1 hower and 29 minutes in lengthe. Then for the nighte the howers appeare

Example.

in the other parte of the table, where the firste hower dooth containe one equall or common hower, and 26 minutes: the seconde hower and the third be of lyke quantitie, and so do they afterwarde decrease vntyll the laste hower of the nyght. An other example: when the son is in the 10 degree of Cancer, bicause I can not fynde that degree in the table, I take the degree nexte vnto it, whiche is the 12 degree, and procedyng with it, I fynde the fyrste vnequall hower to containe 1. equall hower, and 19 minutes: and the second vnequall hower hath in it 1. equall hower and 24 minutes. Nowe for the nyghte I looke in the seconde parte of the table, and fynde the fyrste vnequall hower to bee but 49 minutes in lengthe, and the seconde but 39 minutes, and so in ordre folowinge. This muste I doo when the Sonne is in anye of the northe signes, but if the son be in any of the south signes, the must we accompt the day howers in the second part of the table, & the howers of the night must be sought in the firste parte of the table: in all other pointes I perceaue there is small difference.

an ordre for proportion.

Master. Yet by the way this maye you note, that if you woulde desire more precisely to knowe the iuste quantitie of the howers, for anye suche degree of the Signes as is not expressed in your table, you shall woorke by the rule of proportion, to knowe the more exacte quantitie of the vnequall howers. as for example: In the former worke where you supposed the sonne to be in the 10 degree of Cancer, bicause that degre is not found in the table, you must work by proportion to knowe it, & that in this forme: firste consider the howers against the next nūbre of degrees, as well beneth your degree as also aboue the same, & marke the difference betweene them two, which difference shall alwaies be the secōd numbre

numbre in the Golden rule; and the fyrst noumbre of that woork shall alwaies be 6 degrees, bicause that is the ordinarie exceffe in this table of eche two numbres next together: Now for the third numbre, you shall set the exceffe of your degrees proponed, aboue the lesser degrees in that table, next beneth your said numbre, which in this example is 4, for so much is betwene 6 & 10. And the difference in howers in þ table is but 3 minutes: for against the 6 degree of Cancer, there is but one hower and 16 minutes: and against the 12 degree is set one hower and 19 minutes. Therefore thus doo

I set those numbres accordyng to the golden rule, 
$$\begin{array}{r} 6 \quad 3 \\ 4 \quad 2 \end{array}$$
 saying: If 6 degrees giue three minutes, then 4 degrees muste yelde two minutes. those two must bee added to the lesser numbre, and so dooth there ryse one hower and 18 minutes for the exacte quantitie of the fyrst vnequall hower, the Sonne beeynge in the tenth degree of Cancer.

Scholar. I praye you lette me prooue the same for the seconde hower of the nyght, where against the 6 degree I finde one hower and 47 minutes: and against the 12 degree I see one hower, and 39 minutes, heere the exceffe is 8 minutes: then sette I the figures thus in the golden rule, and say: If 6 yelde 8, then shall 4 giue  $5\frac{1}{3}$ : if I adde these vnto the lesser numbre of time, which is 39 minutes,

Master. You are to farre deceiued, and therefore I interrupt your woordes, for all thinges are to bee gouerned by reason. So that if the howers do increase in quantitie, then is it reasonable to adde the parte proportionable to the lesser numbre of tyme, as it was in the former example: but in this example you see the time dooth not increase, but decrease, (seyng the tyme against 6 degrees is greater then the tyme against 12 degrees) and therefore by good reason the parte proportionable is to be abated from the greater, and not to be added to the lesser.

X.ij.

Schol.

Schol. So is it reasonable: therefore must I take that  $5\frac{1}{3}$  from 47, & then resteth  $41\frac{2}{3}$ , whiche is the precise quantitie of that vnequall hower. And nowe I thanke you, I am fully instructed touching that matter: so that for anye vnequall hower accordinge to the place of the sonne in this latter table, and after the lengthe of the daye in the fyrste table, I canne fynde oute the quantitie of eche vnequalle hower: but these twoo formes doo not make exactly one quantitie of howers vnequall.

*Daies arti-  
ficiall and  
Naturall.*

Master. As in that you shall haue more exacter declaratiō hereafter. And for this present tyme I wyll say no more but that eche of both waies hath good vses. And the fyrst forme whiche seemeth most plaine and leaste artificiall, hath the comprobation of manye men, and namelye of Ptoleme in the ninth chapter of his second booke of Almagestes, but omitting for a time that that remayneth touching howers, I will now speake somewhat of the quantities of daies, in whiche matter you shall call to mynd, that the Naturall daye is not one with the Artificiall daye: for the fyrste is commonly accompted from Sonne risinge one daye, to Sonne rising the nexte daye. but the seconde, that is the Artificiall daye, is reckened only from sonne risinge, to sonne setting: so that there is no night accompted in the Artificiall daye, as there is in the Naturall daye.

Scholar. This I perceauē well inoughe: and farther also, that the Naturall daies are euer 24 howers longe, in all our known cuntries, but the Artificiall daies do increase and decrease diuersely. And as I desire to know the causes therof, so I do meruail how it cometh to passe, that in any cuntry or climat the naturall daies shuld differ.

Master. To the intente that we may proceede ordrely, we wyll begin with the one sorte of daies, and so come to the talke of the other. And fyrste as concerning Naturall dayes, I sayde that they were cōmonly accompted from son rising to son setting: which descriptiō being true, what shal we say  
of

of those northe and southe cuntries, where the Sonne continueth aboute the Horizont in some places three weekes, in other 6 weeks, and so increasing tyll it extend to halfe a year. in al which places if we call the naturall day þ space from son rising to Sonne rising again, then can not the naturall day be of one quantitie to all nations, and so shuld those daies naturall differ in nature, whiche were agaynste nature vtterlye: and therefore dyd I vse that woorde commonlye in the former description: but if I shall define the naturall daye exactlye, I muste call it that iuste tyme in whiche the eigh Sphere or Firmamente dooth exactlye accomplyshe his course, whiche tyme of naturall daye is the common measure of all other tymes: and thys tyme is alwayes equalle in all places, howe be it accordynge to the former description, yf the retournynge of the Sonne bee accompted from anye one parte of the Meridiane lyne, to the same parte of the sayde lyne, then maye that description well extend to all partes of the worlde: for althoughe some nations haue the Sonne in syghte halfe a yeare together, yet dooth the sonne retourne to theyr meridiane lyne towarde the southe, at the eand of 24 howers within a little, and in all places lykewaies where the daye it not full 24 howers, the sonne dooth retourne to their horizont, at the eand of 24 howers nygh hande.

The naturall daye

Scholar. I heare you speake in bothe these declarations, with a doubtfull limitation of the 24 howers, as thoughe that tyme were not the precise or iuste measure of the naturall daye.

Master. So shall it appeare vnto you, yf you consider that the sonne dooth euerye daye runne one degree almoste towarde the east, accordynge to the succession of the signes, as before is mentioned: for if this daye the sonne be in the fyrste degree of Libra iustely at noone, then to morowe at noone hee wyll bee in the seconde degree: and so

the thirde daye hence in the thirde degree: and by the same reason at the monethes eande, wyl the sonne haue passed Libra cleerely, and bee in the beginninge of the nexte signe, whiche is Scorpius: and therefore must he be slacker in coming to the Meridian line, by so muche time as serueth for the risynge of all the signe of Libra in a Righte sphere.

Scholar. That tyme must be an hower and 52 minutes. for (as I remembre) the partes of the Equinoctiall whiche doo serue for the ascension of Libra, are 27 degrees and 54 minutes.

The firste  
cause of di-  
uersitye in  
Naturall  
dayes.

Master. As that is true, so marke what is the difference now for euerye day of that moneth, and then shall you perceau the difference of the Naturall dayes, as muche as dependeth of that cause.

Scholar. For the fyrste degree of Libra, the quantitie of his ascension is 55 minutes of the equinoctiall, whiche maketh in time of an hower 3 minutes and  $\frac{2}{3}$ , and so maye I see for diuers degrees at the beginninge of Libra, by the table of the ascensions in the Right sphere: but towarde the eande of the same signe, I see 57 minutes agreeyng to the ascension of one degree, whiche maketh some difference in tyme also, though it bee small.

Master. Marke now about the middle of Scorpius, howeche degree of the Zodiake hath one degree of the Equinoctiall agreeynge to his ascension, whiche maketh in tyme 4 minutes of an hower: and about the mydle of Sagittarius one degree of the Zodiake hath answerable to him 64 or 65 minutes of the Equinoctiall. and so in other diuers degrees of Signes shall you fynd diuers quantities of their ascensions, whereby it must needs appeare, that if the Sonne dyd moue forward in the Zodiake euery daye one degree iustlye, that the sonne shoulde be 4 minutes after the 24 howers slacker then he was the daye before in touching the meridiane line, if there were not an other cause of diuersitye by the sundrye quantities of the ascensions.

Scholar.

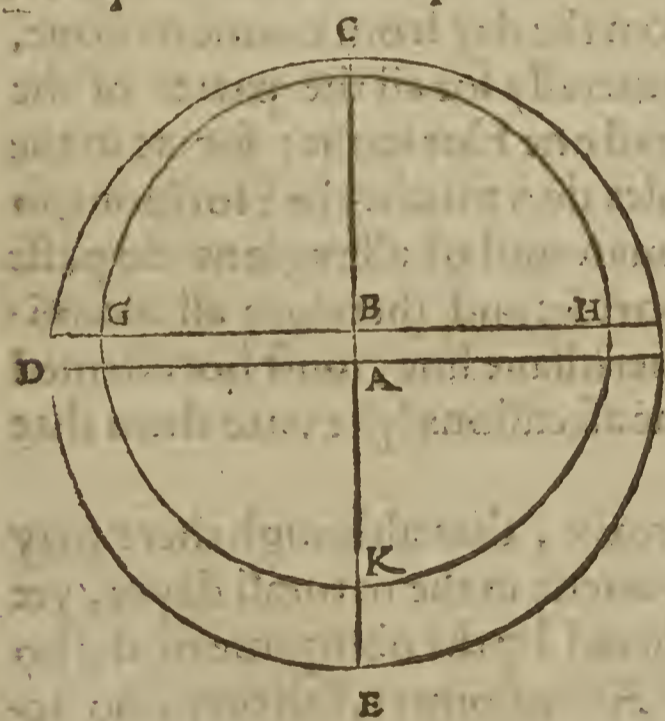
Scholar. This cause is manifest. And bicause I see for some degrees of the Zodiacke but onely 55 minutes of the Equinoctiall, whiche maketh in time 3 minutes and  $\frac{1}{2}$ ; and for other degrees 65 minutes, whiche is 4 minutes and  $\frac{1}{2}$ ; so doth it appeare that the greatest difference is but  $\frac{2}{7}$  partes of a minute; whiche is a small matter.

Master. Yet this small matter will cause much matter in Astronomicall computations, though there were no more difference of diuersitie in Naturall dayes but this only; but yet are there two other causes in all Oblique spheres, and but one in the Right sphere. The seconde common cause in bothe spheres, is the eccentricitye of the Sonne.

Scholar. What meane you thereby? for I doo not vnderstande that eccentricitye.

Master. It is a matter not agreeable for this treatise, but that by occasion I am moued to name it as a concurrente cause touchinge inequalitye of naturall dayes: yet somewhat to saye of it as may suffice for this present; by example you shall vnderstande both what eccentricitye is, and also howe it maye cause diuersitye in naturall dayes: for declaration

The second  
cause of vn  
equal daies  
naturall.



whereof here in this figure you see two circles a greater and a lesser: the greater dooth betoken the eight sphere or firmamente, and the lesser dooth represent the eccentricke circle of the sphere of the Sonne.

These 2 circles as you see, are eccentricke, for that they haue not one common centre, sith the

centre of the greater circle is by A, and the centre of the lesser circle is by B, the distaunce betweene A and B is the quantity

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titie

titie of their eccentricitye. Nowe maye you see that eche circle is diuided into 4 quarters: and lykewise you may se, that the higher halfe of the lesser circle doth not fully answere to halfe the greater circle: and againe the nether halfe of the lesser circle doth occupy more then the halfe of the greater circle. whereby it muste needes bee euidente to all men, that when the Sonne moueth in the higher part of his eccentricke circle, hee doth moue slowlyer then he dooth in the nether parte of the same eccentricke: I meane in comparison to the Zodiake of the eyghte sphere: and thereby must it appeare that the Sonne doth not euerye daye moue lyke nombre of minutes in the Zodiake: and you maye easilye coniecture hereby, that this is an other cause of diuersitye in the quantitye of the naturall dayes. A thyrde diuersitye is that whiche is peculiare to euerye seuerall climate, and not common to anye two on one syde of the Equinoctiall, and that is the obliquitie of the Horizonte, yf the daye shall bee accompted from sonne risynge to sonne risynge againe: but this varietie is so greate and so diuers, that it is in manner infinite: and therefore doo Astronomers reiecte the ordre of accompt of daies, and reckon the day from noone to none, whiche accompte serueth generally for all the partes of the worlde, as if all Climates had one Horizont: for as in the ryghte sphere bothe the Poles doo touche the Horizont, so the meridianes of euery climate and of all regions do passe by bothe the Poles of the worlde: and therefore all ascensions accompted vnto that meridian line, must bee esteemed as ryghte ascensions, I meane ascensions lyke vnto them that be in the ryghte sphere.

The thirde  
cause  
of diuersi-  
tie of daies  
Naturall.

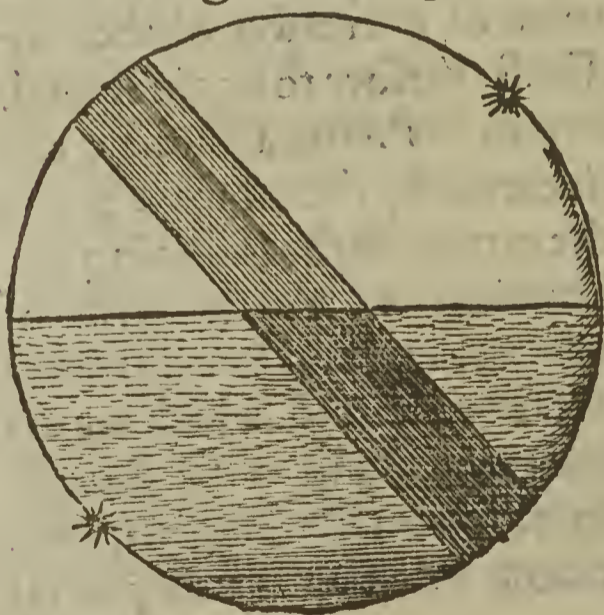
Scholar. Nowe do I perceau, that although there may be assigned thre causes of varietie in the naturall dayes, yet one of them whiche is gathered by the obliquitie of the horizonte in not regarded of Astronomers, sith they doo accompt the beginning of the daye from y noone steede, and the sonne beyng in the meridian lyne. The second cause by  
the

the eccentricitie of the sonne I may coniecture to appertain to a more higher speculation, then this treatise doth admit: but yet may be somewhat vnderstande euen nowe by a small explication. The thirde cause whiche dependeth of the diuersitie of the ascensions by obliquitye of the Horizonte, is peculiare to this treatise, and maye be gathered oute of the tables of ascensions whiche serue for the Ryghte sphere: of all whiche varieties at a time of more conuenient leasure, I will make for mine exercise a table at large. but in the meane season I praye you, proceede as you haue begonne.

Master. Touching the diuersities of Naturall dayes this maye suffice: and for a common and meane quantitie you maye assigne 24 howers and 4 minutes, bicause that is the common nombre: for althoughe many be greater, yet manye other bee lesser. and this nombre is moeste nyghest the meane. Nowe touching Artificiall daies you shall fynde no fewer diuersities: wherein although all the former three causes be concurrent, yet the principall cause is the obliquitie of the Horizont. And althoughe I haue twyse before made mention of those daies, yet doth there rest more to be sayd of them. for in bothe places before I dyd briefly touche the causes of diuersitie of suche Artificialle daies in diuers climates, and in the table of the distinction of climates, I dyd sette forth the quantitie of the longest daye in eche of them: and nowe will I shew you somewhat of the reason of their inequalitye in anye one climate. Fyrst therfore to begin withal, you knowe that before the sonne in his naturall course can passe the full of one degre, he is caried by the violence of the Starrye skye rounde aboute the earth. so that in going betweene the firste degre of Capricorne, and the fyrste of Cancer, he dooth consume halfe a yeare, and therefore maketh aboue 182 reuolutions lyke spirall circles, which are diuerslye parted by the Horizont, accordyng to the diuersities of the eleuation of the Pole. As in the Ryght sphere they are all parted by the Horizont into two equall partes:

*The diuersitie of the artificiall daies.*

so in euerye bowing Sphere, they are vnequally deuided by the Horizont, so that where the north pole is eleuate aboue the Horizont, there those circles of the sonnes reuolutions which be from the equinoctiall northward, haue the greater portion aboue the horizont, and the lesser parte vnder the same: and contrarye waies those circles (or spires if you like better so to call them) whiche be from the Equinoctiall to the tropike of Capricorne, and serue for explication of the Sonnes motion, they haue their greater portion vnder the Horizont, and the lesser portion aboue the same. And comparinge eche one of these to other, that circle whiche is farthest towarde the south, is moste parte vnder the Horizont of anye other. and euerye one of them the more it departeth from the south and draweth toward the north, the greater is his portion that is aboue the horizont, and the lesser is that other portion whiche is vnder the same. wherfore the middlemost bounde of those two extremes, is iuste halfe vnder, and halfe aboue the Horizont: and therfore the sonne beyng in it, doth make his abode iuste lyke tyme aboue the earthe, as he doth vnder it, and therby the daies and nights are equall: but from thence towarde Cancer, the daye dooth still increase aboue the nighte: and from thence toward Capricorne, the daye dothe still abate shorter then the nyghte: which thinge will easilye appear e to the sight, bothe by these



figures here drawen, and also by the diuers positions of the materiall Sphere or globe. And styll the higher that the Pole is eleuate aboue the Horizont, the greater parte of the northerlye circles is aboue the Horizont, and the lesser parte of theym vnder the Horizont. And contrary waies of

of the southerlye circles, the greater portions of them are vnder the horizont, and the lesser portions aboue it. Nowe is it easily perceaued, that seynge the sonne dooth kepe hys daile course in one of those circles, then accorginglye as that circle in whiche the sonne doth moue, is parted by the horizont, so is the partition of the 24. howers into daye and nyghte agreeablye: so that if the circle of the sonnes course be more vnder the horizont then aboue it, then shall the nyghte belonger then the daye: and if the greater parte of the sonnes circle be aboue the horizont, then the day shal exceede the nyghte, in lyke proportion as the partes of the circles are in comparison together.

Scholar. These diuers circles (I perceauē) are not in the sphere of the sonne, but are accompted in the eighthe sphere betweene the two tropikes, so that euery daye by the reuolution of the Firmament, the sonne is caried frome easte to weste rounde about the earthe, and by this violente motion doth describe a spirall circle (as you call it) and not an exact circle: but yet maye it serue in this case, as if it were a iuste circle: the difference is so lytle of the space betweene the spirall lynes in comparison to their compasse, which by the table of declination before expressed, I gesse to bee in proportion scarce  $\frac{1}{1000}$ , which is no part notable in this case. And this farther I note: that two circles on contrary partes of the Equinoctiall equally distaunt from it, are parted by the horizont after one rate, and into lyke portions: but yet in such difference, that the parte of the one circle aboue ground, is equall to the parte of the other that is vnder ground: and so contrary waies. wherby it foloweth, that the day of the one is equall to the nyghte of the other, and so contrarye wayes also. Again seeyng that the sonne dothe descend from Cancer vnto Capricorne, by the same circles of reuolution, by whiche he dydde ascende from Capricorne vnto Cancer, it must needes follow that euery two dayes in the yeare equally distaunte from the longest daye, or from the shortest, are  
equall

equall in their artificiall daye, and in their nighte. These generall thinges I maye easlye gather: but howe I maye knowe iustlye the quantitye of euerye Artificiall daye from other, and the precise tyme of the sonnerisinge and setting, I canne not so easlye gather. wherefore if it please you in those two pointes I desyre your instruction.

Master. Althoughe for this treatise the aptest forme be by the vse of the sphere and the due placinge of it, yet it is harde to place the sphere so well, and to vse it so aptlye, that it myghte declare a iuste precisenes. and therefore after that I haue taughte you the vse of the Sphere for that point, I will also by supputation giue you a table sufficiente to declare bothe vnto you for all partes vnder our parallele, and somewhat more. Firste for the vse of the globe, you muste set it accordinge to the latitude of the Region that you desire to know the daies in, and then marke the degree of any signe that the Sonne is in that daye, whose quantitie you desire to knowe: sette that degree iuste in the horizonte towarde the east, and marke what degree of the equinoctiall is in the horizonte at the same tyme: then tourne the sphere westwarde tyll the degree of the sonne be iust in the Horizonte againe in the west parte, and marke then what degree of the Equinoctiall doth lighte on the Horizont in the east parte, accomptynge trulye howe manye degrees bee betwixte those twoo degrees which you haue marked; and that arke of the Equinoctiall, is called the arke of that day: which you may easlye tourne into howers, accomptynge 15 degrees to an hower, and for euery degree lesse then 15 accompting 4 minutes of an hower.

Scholar. This were easye inough to doo, if I vse the helpe of the table that I see in some bookes, whiche teacheth easly howe to tourne degrees of the Equinoctiall into partes of tyme, as here in Orontius worke it is sette forthe. but I dyd abhrydge it for my selfe as here appeareth: and bicause the table was not extended aboue 60 degrees by Orontius,

I dyd

## A TABLE FOR CONVERTINGE

degrees of the Equinoſtiall into partes of tyme.

The ark of the Equino.	Partes of tyme.		The ark of the Equino.	Partes of tyme.		The ark of the Equino.	Partes of time	
Degree	Houres	Minuts.	Degree	Houres	Minuts.	Degree	Houres	Minuts.
1	0	4	75	5	0	205	13	40
2	0	8	80	5	20	210	14	0
3	0	12	85	5	40	215	14	20
4	0	16	90	6	0	220	14	40
5	0	20	95	6	20	225	15	0
6	0	24	100	6	40	230	15	20
7	0	28	105	7	0	235	15	40
8	0	32	110	7	20	240	16	0
9	0	36	115	7	40	245	16	20
10	0	40	120	8	0	250	16	40
11	0	44	125	8	20	255	17	0
12	0	48	130	8	40	260	17	20
13	0	52	135	9	0	265	17	40
14	0	56	140	9	20	270	18	0
15	1	0	145	9	40	275	18	20
20	1	20	150	10	0	280	18	40
25	1	40	155	10	20	285	19	0
30	2	0	160	10	40	290	19	20
35	2	20	165	11	0	295	19	40
40	2	40	170	11	20	300	20	0
45	3	0	175	11	40	305	20	20
50	3	20	180	12	0	315	21	40
55	3	40	185	12	20	330	22	0
60	4	0	190	12	40	340	22	40
65	4	20	195	13	0	350	23	20
70	4	40	200	13	20	360	24	0

I did for mine owne ease make out the rest in this forme.

Maſt. This is a table of to much ease, and therefore doth rather teache negligence, then anye thinge els. for him that liſteth to excercise his witte in readines of accompte, it is an easy matter to tourne degrees into howers without anye tables, and therefore such tables myght well be spared, & yet

Y.i.

manye

manye booke are full of them: but if you lysted, you might haue abbridged it more frome 15 vpwarde, takinge onelye euen 15 styll. as thus. 15, 30, 45, 60, 75, &c. so seemeth all the reste superfluous, excepte your numbere of degrees in the daye arke, happen iuste agreeable with some one of those in the table: but nowe to procede, giue one example for declaration of your vnderstandinge herein.

Example.

Scholar. Then to begin I sette the globe to the eleuation of 52 degrees, and confidre the place of the sonne the 14 day of Auguste, and fynde it to be by the Ephemerides, in the fyrst beginning of Virgo, therefore do I set the beginning of Virgo in the verye horizont, and then do I see with it the 137 degree of the Equinoctiall in the same Horizont, whiche I doo marke: afterwarde I tourne the sphere tyll the place of the sonne be in the Horizont on the west part, and then in the easte parte I marke the degree of the Equinoctiall, whiche is 347 degrees. Nowe abatinge 137 oute of 347, there resteth the whole daye arke, whiche is 210 degrees, whiche make 14 howers, as by the former table is easily seene. wherfore I conclude that the 14 daye of August, the sonne shineth 14 howers, and then muste the nighte be but euen 10 howers, sith bothe times make iust 24 howers: but yet I see not howe to knowe the howers of the sonne rysinge, and settinge.

Master. I am sure you thinke that the Noone is the middle of the daye, and that the sonne shyneth lyke space before noone and after noone.

Scholar. That is moste certaine.

Master. Then partinge the whole time of the sonne shining, or of the artificial day into 2 equal parts, the one halfe doth limite the hower after none at which the son doth set.

Scholar. That is in this example 7, and so muste it needes be. And now I see by the same reason, the sonne must ryse 7 howers before noone, that is at 5 of the clocke in the mornynge.

Master.

[Master. So is it. And for that eande that you maye haue a generall rule therein, euermore abate halfe the quantity of the daye from 12 howers, and then will the remainer declare the iuste hower and minute of the sonne risynge.

Scholar. Then by your fauoure I will proue ones againe: wherfore I take the 16 daye of Iulye, the sonne beyng in the 3 degree of Leo, which degree I sette in the easte parte of the horizonte, and then doth there appeare in the same Horizonte the 98 and almost  $\frac{1}{2}$  degree of the Equinoctiall: then turnynge the degree of the sonne to the west part of the horizonte, I fynde in the easte parte the 332 and  $\frac{1}{2}$  almoste of the equinoctiall: then subtrayinge the lesser from the greater, there resteth 234: which I turne into partes of time, and it dooth yelde 15 howers and 36 minutes, whiche is the iuste length of that artificiall daye, and of it the one halfe is 7 howers and 48 minutes: wherby I knowe that at 48 minutes, after 7 of the clocke at nyghte, the sonne setteth on that 16 daye of Iuly: and then abating so much from 12, there resteth 4 howers and 12 minutes: so that the sonne risynge appeareth to be twelue minutes after 4. of the clocke in the mornynge. And nowe I thinke my selfe conninge inoughe in all this matter.

Master. Yet for more ease: after that you haue noted the degree of the Equinoctiall that dooth rise with the place of the son, you may marke the degree that riseth with the contrarye point against the son: and abate then the fyrst oute of the second, and so accomplish your woorke, as you did before. for it is all one thinge, but that you need not to loke in cōtrary sides of your sphere for your worke. And this shall you note farther: that if the first ascension of the place of the son be greater then the second ascension of the Nadir of the son, you shal put to the second ascension, 360 degrees, & then abate as you are taught before. As for example: the first daye of February the son is by the Ephemerides in the 22 degree

Y.ij. of

Example.

$$\begin{array}{r} 332\frac{1}{2} \\ - 98\frac{1}{2} \\ \hline 234 \end{array}$$

$$\begin{array}{r} 12\ 0 \\ - 7\ 48 \\ \hline 4\ 12 \end{array}$$

A Cautele.

Example.

of Aquarius, that degree I find in the Zodiak of my spher, and I sette it iuste in the easte parte of the Horizonte, and ther may I se that the  $343\frac{1}{3}$  degree of the Equinoctiall doth ascend at the same instant in the Horizont also: which I must accompt for the true ascension of  $\frac{1}{3}$  degree of Aquarius. Then tourne I to the 22 degree of Leo, beinge the Nadir of the sonne, and with it when it is sette in the Horizonte, I marke the  $125\frac{1}{3}$  degree of the Equinoctiall to ascende. Nowe when I woulde subtracte  $343\frac{1}{3}$  out of  $125\frac{1}{3}$ , it will not be: and therefore I put vnto the lesser numbere 360, and so it amounteth to  $485\frac{3}{4}$ , and then from it I abate  $343\frac{1}{3}$ , and there remaineth  $142\frac{1}{12}$ : whiche if you chaunge into partes of time, do make 9 howers and 30 minutes: and that is the quantitie of the fyrste daye of Februarye.

Scholar. The halfe of that is 4 howers, and 45 minutes, whereby I knowe, that at the 45 minute that is  $\frac{3}{4}$  of an hower after 4 of the clocke the sonne setteth: and riseth in the mornynge 15 minutes, that is  $\frac{1}{4}$  of an hower after 7 of the clocke. But why doo you adde those 360 degrees?

Master. Seeyng wee intende to abate the fyrste ascension oute of the seconde, to thintente that their distaunce maye bee knowne, seeynge the whole compasse of the circle is but 360, from whiche if you abate the fyrste ascension being the greatest numbere, then wyll there remaine the distaunce betwene  $\frac{1}{3}$  ascension & the end of the equinoctial: vnto which differēce you must adde so many degrees as  $\frac{1}{3}$  secōd ascension requireth, as both reason & practise wil declare vnto any mā.

Scholar. It is reasonable. Therefore now it may please you to declare the same woorke by exactnes of tables.

The declaration of the tables.

Master. Bicause you shall not be driuen to seeke in the Ephemerides for the place of the Son, but that one table may serue for it, as well as for the quantities of daies and other conclusions also, I wil make the tables common for fundry vses, whose partes I will fyrste declare, and after that will expresse the vses of them also.

In

## THE TABLES OF QVANTITIES

of dayes Artificiall, and nightes, for  
all Englande.

Signes for the daye.				Elevation of the Pole, or latitudes of Regions.					Signes for the nighte.			
daies of mo neths	degres of Si- gues.	daies of mo neths	degres of Si- gues.	51	52	53	54	55	degres of Si- gues.	daies of mo neths	degres of Si- gues.	daies of mo neths
10	0	13	30	12 0	12 0	12 0	12 0	12 0	0	13	30	10
11	1	12	29	12 4	12 4	12 4	12 4	12 4	1	14	29	9
12	2	11	28	12 8	12 8	12 8	12 9	12 9	2	15	28	8
13	3	10	27	12 12	12 12	12 12	12 14	12 14	3	16	27	7
14	4	9	26	12 16	12 16	12 16	12 18	12 18	4	17	26	6
15	5	8	25	12 20	12 20	12 21	12 22	12 23	5	18	25	5
16	6	7	24	12 24	12 24	12 26	12 26	12 28	6	19	24	4
17	7	6	23	12 28	12 28	12 30	12 30	12 32	7	20	23	3
18	8	5	22	12 32	12 32	12 34	12 35	12 36	8	21	22	2
19	9	4	21	12 36	12 36	12 38	12 40	12 40	9	22	21	1
20	10	3	20	12 40	12 40	12 42	12 44	12 44	10	23	20	29
21	11	2	19	12 44	12 44	12 46	12 48	12 49	11	24	19	28
22	12	1	18	12 48	12 48	12 50	12 52	12 54	12	25	18	27
23	13	31	17	12 52	12 54	12 54	12 56	12 58	13	26	17	26
24	14	30	16	12 54	12 58	12 59	13 1	13 3	14	27	16	35
25	15	29	15	12 58	13 2	13 4	13 6	13 8	15	28	15	24
26	16	28	14	13 2	13 6	13 8	13 10	13 12	16	29	14	23
27	17	26	13	13 6	13 10	13 12	13 14	13 17	17	30	13	22
28	18	25	12	13 10	13 14	13 16	13 18	13 22	18	1	12	21
29	19	24	11	13 14	13 18	13 20	13 22	13 26	19	2	11	20
30	20	23	10	13 18	13 22	13 24	13 27	13 31	20	3	10	19
31	21	22	9	13 22	13 26	13 28	13 32	13 36	21	4	9	18
1	22	21	8	13 26	13 30	13 32	13 36	13 40	22	5	8	17
2	23	20	7	13 30	13 34	13 36	13 40	13 44	23	6	7	16
3	24	19	6	13 34	13 38	13 40	13 44	13 48	24	7	6	15
4	25	18	5	13 38	13 42	13 44	13 48	13 52	25	8	5	14
5	26	17	4	13 42	13 46	13 49	13 53	13 57	26	9	4	13
6	27	16	3	13 46	13 50	13 54	13 58	14 2	27	10	3	12
7	28	15	2	13 50	13 52	13 58	14 2	14 6	28	11	2	11
9	29	14	1	13 52	13 56	14 2	14 6	14 11	29	12	1	10
10	30	13	0	13 56	14 0	14 6	14 10	14 16	30	13	0	9
				H.M.	H. M.	H.M.	H. M.	H. M.				

THE FOURTH TREATISE OF  
The seconde parte of the table.

Signes for the daye.				Elevation of the Pole, or Latitude of Regions.					Signes for the night			
daies of mo neths	degres of Si. gnes.	daies of mo neths	degres of Si. gnes.	51	52	53	54	55	degr. of Si. gnes.	daies of mo neths	degr. of Si. gnes.	daies of mo neths
APRIL.	10 0	13 30	13 56	14 0	14 6	14 10	14 16	14 16	Om	13	30	9 VARY.
	11 1	12 29	14 0	14 4	14 10	14 14	14 20	14 20	1	14	29	8
	12 2	11 28	14 4	14 8	14 14	14 18	14 24	14 24	2	15	28	7
	13 3	10 27	14 8	14 12	14 18	14 22	14 28	14 28	3	16	27	6
	14 4	9 26	14 12	14 16	14 22	14 26	14 32	14 32	4	17	26	5
	15 5	8 25	14 14	14 20	14 26	14 30	14 37	14 37	5	18	25	4
	16 6	7 24	14 18	14 24	14 30	14 34	14 42	14 42	6	19	24	3
	17 7	6 23	14 22	14 28	14 33	14 38	14 46	14 46	7	20	23	2
	18 8	5 22	14 26	14 32	14 36	14 43	14 50	14 50	8	21	22	1
	19 9	4 21	14 30	14 34	14 40	14 48	14 54	14 54	9	22	21	31
	20 10	3 20	14 34	14 38	14 44	14 52	14 58	14 58	10	23	20	30
	21 11	2 19	14 36	14 42	14 48	14 56	15 2	15 2	11	24	19	29
	22 12	1 18	14 40	14 46	14 52	15 0	15 6	15 6	12	25	18	28
	23 13	31 17	14 44	14 50	14 56	15 3	15 10	15 10	13	26	17	27
	24 14	30 16	14 46	14 54	15 0	15 6	15 14	15 14	14	27	16	26
	25 15	29 15	14 50	14 56	15 4	15 10	15 18	15 18	15	28	15	25
	26 16	27 14	14 54	15 0	15 8	15 14	15 22	15 22	16	29	14	24
	27 17	26 13	14 56	15 4	15 11	15 18	15 26	15 26	17	30	13	23
	28 18	25 12	15 0	15 8	15 14	15 22	15 30	15 30	18	31	12	22
	29 19	24 11	15 4	15 10	15 17	15 26	15 34	15 34	19	1	11	21
	30 20	23 10	15 6	15 14	15 20	15 30	15 38	15 38	20	2	10	20
MAYE.	1 21	22 9	15 10	15 18	15 24	15 34	15 42	15 42	21	3	9	19
	2 22	21 8	15 12	15 20	15 28	15 37	15 45	15 45	22	4	8	18
	3 23	20 7	15 16	15 24	15 32	15 40	15 48	15 48	23	5	7	17
	4 24	19 6	15 18	15 28	15 36	15 44	15 52	15 52	24	6	6	16
	5 25	18 5	15 22	15 30	15 39	15 47	15 56	15 56	25	7	5	15
	6 26	17 4	15 24	15 34	15 41	15 50	16 0	16 0	26	8	4	14
	7 27	16 3	15 28	15 36	15 44	15 54	16 4	16 4	27	9	3	13
	8 28	15 2	15 30	15 40	15 47	15 57	16 7	16 7	28	10	2	12
	9 29	14 1	15 34	15 42	15 50	16 0	16 10	16 10	29	11	1	11
	10 30	13 0	15 36	15 44	15 54	16 4	16 14	16 14	30	12	0	10
			H. M.	H. M.	H. M.	H. M.	H. M.	H. M.				

## The thyrde parte of the table.

Signes for the daye.				Elevation of the Pole, or latitude of Regions.					Signes for the nighte.			
daies of mo neths	degres of Si- gnes.	daies of mo neths	degres of Si- gnes.	51	52	53	54	55	degres of Si- gnes.	daies of mo neths	degres of Si- gnes.	daies of mo neths
11	II 0	13	30	15 36	15 44	15 54	16 4	16 14	0 4	12	30	10
12	1	12	29	15 38	15 46	15 56	16 6	16 17	1	13	29	9
13	2	11	28	15 41	15 49	15 59	16 9	16 20	2	14	28	8
14	3	10	27	15 44	15 52	16 2	16 12	16 24	3	15	27	7
15	4	9	26	15 46	15 54	16 4	16 14	16 26	4	16	26	6
16	5	8	25	15 49	15 57	16 7	16 17	16 29	5	17	25	5
17	6	7	24	15 52	16 0	16 10	16 20	16 32	6	18	24	4
18	7	5	23	15 54	16 2	16 12	16 22	16 34	7	19	23	3
19	8	4	22	15 56	16 5	16 15	16 25	16 37	8	20	22	2
20	9	3	21	15 58	16 8	16 18	16 28	16 40	9	21	21	1
21	10	2	20	16 0	16 10	16 20	16 30	16 42	10	22	20	31
22	11	1	19	16 2	16 12	16 22	16 32	16 44	11	22	19	30
23	12	30	18	16 4	16 14	16 24	16 34	16 46	12	23	18	29
24	13	29	17	16 5	16 15	16 26	16 36	16 48	13	24	17	28
25	14	28	16	16 6	16 16	16 28	16 38	16 50	14	25	16	27
26	15	27	15	16 8	16 18	16 30	16 40	16 52	15	26	15	26
28	16	26	14	16 9	16 19	16 31	16 41	16 54	16	27	14	35
29	17	25	13	16 10	16 20	16 32	16 42	16 56	17	28	13	24
30	18	24	12	16 12	16 22	16 34	16 46	16 58	18	29	12	23
31	19	23	11	16 13	16 23	16 35	16 47	16 59	19	30	11	22
1	20	22	10	16 14	16 24	16 36	16 48	17 0	20	1	10	21
2	21	21	9	16 15	16 25	16 38	16 50	17 2	21	2	9	20
3	22	20	8	16 16	16 26	16 38	16 51	17 3	22	3	8	19
4	23	19	7	16 17	16 27	16 39	16 52	17 4	23	4	7	18
5	24	18	6	16 18	16 28	16 40	16 53	17 4	24	5	6	17
6	25	17	5	16 19	16 28	16 40	16 53	17 5	25	6	5	16
7	26	15	4	16 20	16 29	16 41	16 54	17 5	26	7	4	15
8	27	14	3	16 20	16 30	16 42	16 54	17 6	27	8	3	14
9	28	13	2	16 20	16 30	16 42	16 54	17 7	28	9	2	13
10	29	12	1	16 20	16 30	16 43	16 54	17 8	29	10	1	12
11	30	11	0	16 20	16 30	16 44	16 54	17 8	30	11	0	11
H.M. H. M. H. M. H. M. H. M.												

in the firste colunne are set the daies of the monethes, and in the second the degrees of the Signes in the Zodiake, in whiche the sonne is that daye: so likewise the thirde and fourth colunne do serue for the like matter, seeing twise in the year the daies are equall. And bicause at other 2 times in the year the nights are equall to those daies, therefore on the right hand of the table are ther 2 colunnes of moneths, and other two colunnes of signes agreeable therto, in which those nights are equall with the daies of the monethes on the lefte hand, and therefore at the title set ouer the signes & moneths on the lefte hand, signes for the day: and on the right hande signes for the nighte: that is to saye, that if the moneth and signe for which you seke, be on the left side of the table, then do the numbres vnder the eleuation of the Pole declare the quantitie of the day: but if the monethes & signes be on the right side, then is that quantitie the length of the night. and ouer the 5 middle pillers, you se the title to be the Eleuation of the Pole, or latitude of regions, whiche are there but only 5 expressly set, namely 51, 52, 53, 54, & 55: whiche may serue for all Englād, from the south sea vnto Scotlād. And so may it do for diuerse of the northe partes of Europe and Asia. Nowe for the vse of them, this is the ordre. When so euer you wold know the quantitie of the daye Artificiall and of his night, seeke out the day in the colunnes on the right hande, or on the lefte hand as it will chaunce, and by it in the next colunne you may see the place of the Son in the Zodiake: then going right forth towarde the middle of your table tyll you come directly vnder the colunne that serueth for your Region in latitude, there shall you finde 2 numbres: the first be tokening howers, and the second minutes of howers, which declare the iuste quantitie of the day for the moneths on the lefte hande: or els if the moneth that you seeke for be on the right hand, then do those numbres of howers and minutes betoken the quantitie of the nyghte.

Scholar. I perceauē it well, and I se by reason it must nedes  
be

be so: as for examples sake. the 24 daye of Auguste I desire to knowe the lengthe of the day and the place of the Sonne in the Zodiacke: wherfore fyndyng the saide 24 daye in the fyrste table of those thre ryght against it, I may see the place of the sonne, whiche is then the 11 degree of Virgo: and from thence proceedinge forth righte towarde the myddle of the table, I fynde vnder the numbre of 52 degrees of latitude 13 howers and 19 minutes: whereby I perceauethat the Artificiall daye from sonne rysyng to sonne settinge, is so longe with vs: and the nyght is the reste of 24 howers, that is 10 howers and 42 minutes. And the lyke quantities of daye and nyght must needes be the 29 daye of marche, when the sonne is in the 19 degree of Aries. But on the 20 daye of February, the sonne beyng in the 11 degree of Pisces, that 13 howers and 19 minutes is the quantitie of the nyghte, and the day then is but 10 howers and 42 minutes in length: and so likewaies the seconde daye of Octobre, when the sonne is in the 19 degree of Libra.

Master. This is sufficiente: for as you haue doone in this so maye you doo in all other lyke. yet for the more certenty I will proue you with one question more: For London whiche is supposed to be 51 degrees and 24 minutes in latitude, I woulde knowe the quantitie of the daye Artificialle when the sonne is in the 28 degree of Scorpio.

Scholar. I fynde that signe of Scorpio in the second table on the right hand, and the 10 daye of Nouembre answeriug vnto it. And bicause 24 minutes are lesse then halfe a degree, I do seeke the quantitie of the daye vnder 51 degrees rather then vnder 52, and so fynde I 15 howers and 30 minutes: whiche in this case is the quantitie of the nyghte, as the title declareth that is ouer those signes: therfore the lengthe of the daye is 8 howers and 30 minutes.

Ma. You haue done well. But yet for an exacter precisenes, you may take the part proportionable for the odde minutes of the eleuation, as thus. for the latitude of 51 degrees, the

day

A cautele  
for the part  
proportion-  
ble.

daye is 8 howers and 30 minutes: and for 52 degrees, it were 8 howers and 20 minutes: so are there 10 minutes difference betweene those two eleuations. Then saye by the Golden rule: If 60 minutes giue 10, what shall 24 minutes giue? and it will appeare to bee 4 minutes. Those 4 minutes muste I abate frome the greater noumbre in this example (and in all this worke wher the num-  

$$\begin{array}{r} 60 \\ 24 \overline{) 10} \\ \underline{24} \phantom{0} \\ 4 \phantom{0} \end{array}$$
bres decrease) and it will yelde 8 howers & 26 minutes: where as yf you did fynde the numbres to increase, then should you adde those partes porportionable vnto the lesser numbre, as by prooffe you may try, for that day when the sonne is in the seconde degree of Leo.

Scholar. That is (by the second table) the 15 daye of Iuly, and then is the daye in lengthe 15 howers and 30 minutes, in the latitude of 51 degrees: but in the latitude of 52 degrees, it is 15 howers and 40 minutes, so it increaseth 10 minutes: and therfore muste I adde the parte proportionable (which is 4 minutes as before) vnto 30. and so haue I the true quantitie 34 minutes aboue 15 howers. And nowe I thinke I am perfecte inoughe for all places betweene 51 degrees of latitude and 55: but for other places I knowe no suche waye.

Master. It were to longe a woorke to sette out all diuersities of eleuations, and scarce agreeable for this treatise, wher these thinges are but incidente, and not principall matters: but at other times in more conuenient place it shall be done if I maye vnderstande this my labour to be profitably imployed. And the also will I make explicatiō of dyuers other matters, whiche you did in your table at the beginning of this treatise propounde, although at this time I thinke many of them lytle appertaining to this booke. But yet before I eande this treatise, I must speak somewhat of twoo or three matters more: And firste of the chieffe Constellations and figures in the Starry skye. For a ground you shall note, that the starres are not only in multitude infinite, but many of them also so smal, that scarce any mans eye can discern them.

wher-

Constella-  
tions.

wherefore to auoide confusion, and to growe to a certenty, the auncient Astronomers did note only 1022 starres, wher of the moſte parte they did aſſigne to certain limites, encloſing them in figures of men, beaſtes, or other formes, and accordinglye gaue them names, partly that they might the more eaſily bee remembred, partlye for remembraunce of ſome woorthy faſte, and partly alſo for ſome notable ſignification of the ſtarres comprehended in eche of them. All whiche matters I will nowe ouerpasse, tyll a more conuenient place, and will repeate onely their names and places generally, diſtincting them accordynge to the accuſtomed manner, into three ſortes: whereof the one ſorte are called Northerlye conſtellations, the other ſorte Southerly conſtellations, and the third ſorte are the twelue ſignes, which paſſe in the myddle betweene ſouthe and northe: for heere in this place I meane not to referre ſouthe and north to the Poles of the Equinoctiall, but as all learned men before me haue doone, to the poles of the Zodiacke. And ſo may the Zodiacke be accompted exactly in the myddle. But nowe to beginne as Ptolemye doth, with the northerly conſtellations: The moſte northerly conſtellation is the leſſer Beare, called *Vrſa minor*, and *Cynosura*, and contayneth in it 7 ſtarres. This is the chiefe marke whereby mariners gouerne their courſe in ſaylinge by nyghte, and namely by 2 ſtarres in it, which many do call the Shaſte, and other do name the Guardas, after the Spaniſh tonge. Nigh vnto it is the greater Beare, called *Vrſa maior*, contayninge 27 ſtarres, whereof 7 are moſte notable, and are in latine named *Plauſtrum*, and in english Charles waine, which ſerueth alſo well in ſaylinge: and manye of the olde Greekes obſerued it onely in their nauigation, as the Sydonians and all the Phenicians marked the leſſer Beare. Aboute theſe 2 Beares is there a longe trace of 31 ſtarres, comonly called the Dragon. Then foloweth *Cepheus*, whiche conſiſteth of 11 ſtarres.

Bootes alſo is in the ſame coaſte, whome *Proclus* and others

The northe  
coſtellatiōs

1  
*Vrſa minor*

2  
*Vrſa maior*

3  
*Dragon*

4  
*Cepheus*

5  
*Bootes*

thers

- 6  
 The northe  
 Crowne.
- 7  
 Hercules.
- 8  
 Lyra.
- 9  
 The Swan.
- 10  
 Cassiopeia.
- 11  
 Perseus.
- 12  
 The Carter
- 13  
 Serpētarius
- 14  
 The serpent
- 15  
 The Dart.
- 16  
 The Egle.
- 17  
 Antinous.
- 18  
 The dolphin
- 19  
 The Fores  
 horse.
- thers doo name Arctophylax: and it hath 22 starres, beside  
 one very bryght starre called Arcturus, which standeth be-  
 tweene Bootes legges. By Arctophylax ryghte hande, is  
 the northe Crowne, called also Ariadnes Crowne, and hath  
 in it 8 starres. Then foloweth Hercules, whom the greekes  
 doo call Engonasin, as it were the Kneeler, bicause of his  
 gesture: and it containeth 28 starres. By hys lefte hande,  
 is there an other constellation, whiche is called the Harpe,  
 in latine Lyra and Fidicula, and also Vultur cadens, that is  
 the fallynge Grype; it comprehendeth 10 starres. By it is  
 the Swanne, named Cygnus, and Auis generallye, as the  
 Greekes call it Ornīs, whiche some men of to muche ouer-  
 syght do translate, Gallina a Hen: it consisteth of 17 starres.  
 After it dooth Ptolomye reckon Cassiopeia, whiche is by  
 Cepheus, and hath 13 starres. Nexte vnto hir is Perseus,  
 with Medusas headde, and it includeth 26 starres. Then  
 foloweth Erichthonius, with the Goate and the 2 Kyddes.  
 this constellation is also named Auriga the Cartar: and cō-  
 taineth 14 starres with one in his right foote, which is com-  
 mon to Taurus also. An other constellation is there which  
 ioyneth heade to heade with Hercules, and is called of the  
 Greekes, Ophiuchus, and of the latines Serpentarius, that  
 is the manne with the Serpente, or Serpent bearer: and it  
 hath 24 starres. Belyde the Serpent, which containeth 13  
 starres in him selfe, and is named of latines Anguis, and of  
 greekes Ophis. Then is there an other small constellati-  
 on of 5 starres, a lytle southe of the swannes heade, and it is  
 named the Darte, Sagitta or Telum in latine, and in greke  
 Oistos. By it towarde the southe, is the Egle, includynge  
 9 starres: hee is called not onelye Aquila in latine, but also  
 Vultur volans, and in greeke Aetos. Vnder it towarde the  
 south is a constellation harde adioyning named Antinous  
 in all tonges, and hath but 6 starres. A lytle from it is the  
 Dolphine, whiche hath in it 10 starres.  
 Then foloweth the Forehorse, noted with 4 darke starres,  
 and

and harde by him is the Flying horse, named Pegasus: and doth consist of 20 starres. Vnto him ioyneth Andromeda, so that hyr headde lyeth on the nauell of Pegasus, and one starre is common to them bothe. This constellation dothe containe 23 starres.

The Flying  
Horse.

21

Andromeda

By hir lefte foot is ther a small constellation of 4 starres, which is commonly called the Triangle, and in latine Triangulus, but the greekes name it after one of their letters Delta and Deltoton. And thus haue I briefly reckened all the northely constellations, excepte Berenices heare, of whiche I will speake laste of all other. And therefore nowe nexte in due ordre muste the 12 signes followe: amongst whiche Aries occupieth the fyrste place, and contayneth 13 starres. Then Taurus whiche is adorned with 33 starres, wherof 5 be in his forehead and face, and are called of the Greekes Hyades, and of the latines Succule: amongst whiche, one is more notable then all the reste, and is called Oculus Tauri, the Bulles eye: but the Greekes call it Lampadidas, and the latines Palilicium: the Arabitians Aldebaran. Other 6 starres (as Proclus numbred them, though other accompt them 7) are in the backe of this signe, and be called Vergiliae in Latin, and in Greeke Pleiades, and also Atlantides: they are named in englysh the brood Henne, and the Seuen starres, yet they cluster so nyghe together, that it is harde to numbre them truly, and therefore many do disagree in rekenynge them.

22

The triagle

2

Aries.

2

Taurus.

Water stars

The seuen  
starres.

3

Gemini.

After Taurus, Gemini do followe, whiche comprehend 19 starres: of whiche twoo beare name as most famous, and they are in their headdes: the formost is named Appollos headde, and the nexte is called Hercules headde, because those two Twinnes were so named of some men, yet other doo call them Castor and Pollux. Before their formoste foote is there one fayr star (beside the 18,) which therefore is named in greke Propus. After Gemini foloweth Cancer containing 8 stars, beside a cloudy tract which is named

Propus.

4

Cancer.

Crybbe.

Z.i.

Manger

Asses.

5

Leo.

Manger or Crybbe. Other two starres are called the Asses whiche seeme to stande at the Crybbe. Then the Lion is nexte, as a princely signe, in whome are 27 starres, but two of them more notable then the reste: the one is in the tayle, and therefore is called Cauda Leonis, the other in the brest and is called the Basyliske or Kyngeley starre, and also the Lions harte, Cor Leonis in Latin, and Basiliscos in greke. Nexte after Leo, cometh Virgo, garnished with 26 starres, but one especially glystereth aboue the reste, and is called Spica Virginis, the Virgins spike.

6

Virgo.

A lesser starre there is also, whiche yet is notablie marked, and called Protrigetes, Præuindemiator.

7

Libra.

After Virgo cometh Libra, the signe of Iustice and equitie: but it is the leaste signe in quantitie of all other in the Zodiake, for it occupieth scarce halfe a signe in lengthe, and no meruaile, syth that cruell Scorpius dooth inuade so greate a portion, and presseth all that Sygne oute righte. yet hathe it 8 starres, but not one out of the Scorpions claws.

8

Scorpius.

Then Scorpius with his hooked tayle, and with his claws doth reache so farre, that two full signes he taketh in length and 30 degrees almoste in bredth, yet hath he but 21 starres beside those whiche bee in his claws, and are common to them & to Libra: amongst all which the principall is that, whiche is called the Scorpions harte, and is named of the Greekes Antares, and of Arabitians, Calbalatrab.

9

Sagittarius

After him ensueth one of the Centaures lyke an archer on horse backe, with manye fayre starres, though they bee not of the greatest: he hath in all 31. this signe is called Sagittarius in latine, and in greeke Toxotes. Capricorn then followeth with his monstrous shape, nother fysh nor flesh, but myxed of both: a winterly signe and no waies pleasant, but that he geueth hope of the cōfort of the Springe, bicause in it the sonne beginneth to retourne to vs againe. hee hath in him 28 starres of meane quantite.

10

Capricorn.

Aqua-

Aquarius so faste dooth followe him at hande, that hee reacheth almoste as forwardlye as Capricorne, within lesse then 8 degrees: this signe hath in him 22 starres peculiere to him selfe,, althoughe Proclus name 4 of them in hys ryghte arme, to be the Water pottle. But besyde these 22 starres, there are other 19, whiche in their dyuers and crooked position doo make a forme of a Ryuer, and are called the Water whiche Aquarye sheddeth. With these 19 starres Ptoleme doth accompte one more, whiche is a beu'tifull starre of the bryghtest sorte, and is in the mouth of the Southe fyshe, so that it is common to them bothe, this star is called of Arabitians Fomahant: so that in all there are reckened in this signe, 42 starres.

La'ste of the 12 signes commeth the Fyshes, tyed by the tayles with a common Lyne: the forme'ste Fyshe hath but 8 starres, and his line hath 10. the latter Fishe hath 11 starres, and his lyne hath but 5. and where those two lines are knitted togyther, there is one starre more, whiche is called the Knotte, that is in Greeke named Syndesmos: so that all the starres togyther, of this signe, are 34.

Whether Proclus did mistake any thinge in this signe, I wishe other to iudge, bicause I intended here not to intreat at large, and muche lesse to scan other mennes writinges. And thus wyll I eande the 12 signes of the Zodiake.

Nowe to diuer'te vnto the southe signes: fyrste appeareth the greate Whale, contayning 22 starres, whereof three bee molte noted: the fyrste in the nether chappe, whiche is in latine called Mandibula ceti, and in Arabike Menkar. the seconde is called the Whales bellye, in Arabike Baten kaitos, and in Latine Venter Ceti. the thirde is the Whales tayle, named Cauda ceti in latine, and in Arabike Deneb kaitos. Nexte foloweth Orion, the Stormy signe, and hath diuers starres to the numb're of 38: but the mo'ste notable are 6. the fyrste is in his ryghte shoulder, and is called by the

Z.ij. Ara.

Arabitians Bed Algeuze. The second is in the leste shulder and is named Bellatrix. Other thre stande as bullions set in his gyrdle, and are called of manye englyshe men the Golden yarde. Then is there in his leste foote, a greate starre of the brightest sort, which is named of Arabitians Algebar, and Rigel Algeuze. Beside these sixe there are other starres more notable for their forme then for their quantities. as the two starres which betoken his clubbe in his right hand, and 9 starres by his leste hande, whiche represente a Lions skynne: and other three doo limite his sworde, lying crosse his backe vnder his girdle.

Betweene Orion and the Whale is there a greate tract of starres, whiche represent the forme of a Riuer: and therefore are they called the Ryuer. whiche some more peculiarly name Eridanus, and other Nilus. Proclus calleth it Orions ryuer, bicause it beginneth at his leste foote and hath one starre common with his foote, but beside that it hath 34 starres: wherof the laste is one of the greatest lyght.

By the beginninge of this Ryuer, vnder the feete of Orion is there a constellation of 12 starres, named the Hare. And after it toward the easte is the greater Dogge, (of whō the Caniculare daies bear name) and is called of the grekes Sirius, and of the Latines Canis, hauing 18 starres, but one especially in bryghtnes more notable then anye of the rest,

and that is in his mouthe, and is called peculiarlye Sirius and Canis, by the name of the whole Signe, and of the Arabians Alhabor. Northe almost from this Dogge is there a constellation of 2 only starres named Canicula, the lesser Dogge: and in greeke Procyon, the fore dogge, whō Tully therefore calleth Antecanis, and other name him Precanis.

At the tayle of the greater Dogge is the famous shippe Argo, whiche comprehendeth 45 starres, wherof 3 bee bewtiful but one in especiall which is in the foote of the roother. is called Canopus, & of the Arabitians Suhel. This star is not seen in Englād, France, Germany nor Italy, & scarssly in the

the moſte ſoutherly partes of Spaine. And here by the waye I will note a place in Proclus very much corrupted, whiche nowe I will only correct as I thinke good: and an other time will intreate more largely of it and of other mo. the wordes in Greeke are theſe.

ὁ δὲ ἐν ἄκρῳ τῆς πρὸς ἀλὶν τῆς ἀργούσης κείμενος λαμπρὸς ἀστὴρ. καὶ νῶτον δὲ οὐδὲ μᾶλιστα, ὅς τις μὲν ἐν ῥόδῳ μόλις θεωρητὸς ὄσιν, ἢ παντελῶς ἀφ' ὑψιλῶν τόπων ὄρατός. ἐν ἀλεξανδρίᾳ δὲ ἐστὶ παντελῶς \*ἐμφανής. σχεδὸν γὰρ τέτατον μέρους ὡς δὲ ἀπὸ τοῦ ὀρίζοντος μετεορίσμενος φαίνεται.

\*ἀφανής  
in all the  
Greeke  
bookes.

Stella vero illa splendida quę in imo Argus gubernaculo sita est, Canopus dicitur. ea in Rhodo vix conspicitur, aut certē ab editis locis. In Alexandria vero prorsus \*conspicua est, vtpote ferē quarta signi portione supra Horizontem euecta.

Non cer  
nitur. trās  
tulit lati  
nus inter  
pres, gre  
ci codi  
cis erro  
rem imi  
tatus.

The bright starre in the foote of the roother of Argus is called Canopus, whiche in the Rodes can scantely be seene, excepte it be from highe places: but in Alexandria it maye well be seene, for it doth rise there nyghe a quarter of a signe aboue the Horizont.

Scholar. This is contrarye to the common translation.

Master. And that common translation is as contrary to common sense, but therof an other time shall we talke, when I mynd to teache you the exacte ordre of ascension for all these constellatiōs, and of their chiefe starres also. And now to proceede as we began. Nexte after this ship ther foloweth the great Serpent whiche is called of the greekes and latines Hydra. it containeth 25 starres, and stretcheth in greate lengthe by the space of 3 whole signes. one starre there is in it bryghter then the reste, and that is named by the Arabians, Alphard.

8  
The Ser  
pent of the  
southe.

On this Hydre there resteth other 2 small constellations, the one named the Cuppe, and the other the Rauē.

9  
The Cupps

The Cuppe includeth seuen starres all of one bygnēs. This Cuppe standeth on the Hydres backe, almoste in the myddle of him.

Z. iij.

The

10  
The Raucn.

The Rauē standeth on the same Hydre, more nearer towarde the pointe of his tayle: and it is formed of 7 starres also, of whiche that which is in his lefte wing, is called in Arabike, Algorab.

11  
The Centaure.

The Centaurs spear

Vnder the taile of this Hydre and those twoo other small constellations, there standeth the centaure Chiron, lyke a lyghte horseman with his chasinge staffe: he hath in him 37 starres, whereof 4 be in the garnishe or pensile of his spear, and them doth Proclus reckon as a peculiere constellation, and nameth it in greeke Thyrsolochus. And Ptolemy doth reckon those starres naming them to be in that speare: wherefore I muse howe Stofler seemed so ignoraunte herein, to deny that Ptolemye doth make any mention of that spear, and hym selfe deuise oute of Ptolemye 6 wronge starres for that purpose: it appeareth hee was deceaued by the olde translation, where Clypeus is translated for Hasta: that is, shielde for speare. whiche wrong translation Schoner, Copernicus, and Erasmus Rheinhold doo follow, and dyuers other learned men, but against reason.

Scholar. I thinke it (as manye thinges els be) is receaued by credite of authoritie, withoute disquisition of reason, whiche blyndeth manye wittye men oftentymes.

12  
The Wolfe.

Master. Yet is their faulte the more pardonable, if they acknowledg their errour when thei be friendly admonished: but this is beside our purpose at this time, therefore to returne: This Centaure with his righte hande dooth holde a Wolfe, whiche is a feuerall constellation made of 19 starres, althoughe Hyginus and others doo reckon fewer in him, as they doo vnrulye in manye other. Vnder that beaste towarde the southe, harde vnder the Scorpions tayle, standeth the Altar, made of 7 Starres, of the meanest lyght: but it is not seene in Englande aboue the Horizont. By this Altar eastwarde betweene the two former feete of Sagittarye, there is the Croune of the southe, formed of 13 small starres: Proclus and Theon doo call it also Vraniscus, as manye later

13  
The Altar.

14  
The southe Croune.

writers

writers in their tyme did name it: but Theon dooth farther affirme that it hath 15 starres: whiche muste seeme to bee an errour, rather in the booke then in the author: wherein obseruation canne not heape vs in Englande, fyth it riseth not aboue our horizont, but only toucheth it.

After it foloweth the Southe fysh, containyng 12 starres: wherof one only is of the greatest lyght, and that is it which standeth also for the eande of the water that runneth frome Aquarius. This fysh lyeth betweene the constellations of Capricorne and Aquarye, so that it is partely vnder them bothe.

15  
The southe  
Fishe.

These bee the Constellations most commonlye noted, amongest auncient writers: howbeit one more there is named to lye betweene the Lions taile and Vrsa maior, whiche is called Berenices heare, some call it in latine Trica, and other Berenicis crines. Conon that famous astronomer dyd fyrste name it, and Callimachus did declare it, and therefore doth Proclus adscribe the fyrste noting of them vnto Callimachus. The starres in it are 7, as Hyginus and Bassus do accompt them: but they are verye darke, and therefore Ptolemye doth numbre only thre of them, as the boundes of that forme. Besyde these 50 constellations, there bee a greate numbre of starres, whiche be not assigned to any figure, but lye disperedly about those other constellations, whereof 61 are in the northe parte of the skye, and annexed with the northerly signes: and other 19 in the southe part of the Zodiake, vnto whiche if you adde 337 whiche be in the northe constellations, and 316 in the southe constellations, with 292 in the Zodiake, so haue you in all 1025 starres whiche be noted by Astronomers, but in Ptolemys accompte there appeare but 1022, bicause he doth not accompte anye starre of Berenices heare, but called it the Traces of heare. These starres be not of one quantity, but som much brighter then other, and therefore are they distincte into diuers measures of lyght, and namely 8, whiche are called the first

16  
Berenices  
heare.

61  
19  
337  
316  
292  
1025

Z.iiij.

greatnes

greatnes, the seconde, the thirde, the fourthe, the fyfte and the  
lyxte, vnder whiche they are that be called Cloudy starres:  
and a lesser sorte yet named Darke starres: of all which, and  
the measure of their quantitie, I will at an other tyme speak  
more fullye, for this place and time agreeth euell with the  
matter, and that muche worse, then at the beginning it see-  
med to doo.

Scholar. There remaine yet manye tytles vntouched of  
them whiche I gathered.

Master. And manye of theym finally agreeable for this  
treatise, but doo more aptly appertaine to Cosmography,  
and therefore ought to be reserued for that worke: saue that  
some of them are peculiare for the Theorike of Planetes;  
and yet will I lightly touch them in fewe words, for so much  
as may seeme to heape to this treatise.

Howe the  
numbre of  
spheres is  
knowne.

Scholar. I remembre at the beginnunge you promised to  
shewe a cause why you name but 8 spheres, where as other  
men do accompte more: and also how it may appeare, that  
there are so manye, for the eyes can see but one only, whiche  
is the firmament.

The Moone

Master. Your selfe sayde, you had marked (as many ma-  
riners, yea and all men do almoste) that the Moone dothe  
euerye daye runne eastwarde notably, so that in a weeke shee  
passeth a quarter of the skye in that course, and in 15 daies  
she runneth halfe the compasse of the skye, and so in a mo-  
neth she retourneth to the sonne againe, hauinge passed all  
the circuit of heauen. so of the Sonne you haue vnderstand  
that in a yea he trauerseth ouer all the lengthe of the Zo-  
diake, contrary to the course of the Firmament, whereby it  
muste needes appeare vnto you, that seeynge the sonne and  
the moone haue courses distinct from the Fixed starres, thei  
muste needes haue distincte spheres also, wherein they doo  
moue, and accomplishe their courses.

The Sonne.

Scholar. I remembre I haue hearde it often repeated as a  
principle in nature, that one symple body can haue but one  
symple


symple motion: and therefore where diuers motions bee, it muste needes followe that there are diuers bodyes as theyr workers, whiche you in this talke do call spheres.

Master. As you may thinke that their spheres are distincte from the Firmament by reason of their seuerall motions, so are they distincte a sonder by the same reason.

Scholar. It is moste certaine.

Master. Then if by good obseruation it haue bene proued, that there be 5 other starres which haue their motions all distincte from the Starry skye, and eche of them frome their fellowes, it will appeare reasonable that euerye one of them hath a seuerall sphere peculiare for him selfe, and for his priuate motion.

Scholar. It will followe of necessitye.

Master. Then I will beginne with your selfe for one of them, whiche I am sure you can not but marke, as all men, yea the verye Plowmen doo. And that is Venus, whiche I dare saye, you haue marked in the euenynge to set after the sonne, & then is she named the euenyng star, & yet doth she not at al times shine like space after son setting, but some times more & somtime lesse. And if you marke hir well, then shall you perceaue, that the fyrste nyghte that she appeareth, shee shyneth lesse time then she dothe the seconde nyght, and so increaseth the tyme of hir shyninge for a space, and then dothe shee abate againe by lyttle and lyttle, tyll she ioyne with the sonne, and then appeareth no more at euenynge, but shortly after will she shoue in the mornynge before the sonne rysynge, and increase the time of hir shining by litle and lytle, tyll she comme to the farthest of  staunce fro the sonne, and then will she abate againe in lyke manner, till she come within the beames of the sonne, and leese hir ap-  
pearynge for a tyme.

Scholar. This is moste certaine and knowne of all men: vulgarly, althoughe fewe men doo considre the cause thereof: but nowe I doo remembre, what you taught me of the  
ascen-

ascensions poeticall (as they be named) and namely of that whiche you thought meter to bee called apparition, whose contrary you called Occultation: so that when Venus doth shyne at euenynge after sonne settinge, she dothe rise as som tearme it, with a sonnely rysinge: and when shee is hydden againe, she is set with a sonnely settinge. but that you iudge Apparition and Occultation more apter tearmes.

Master. You doo not gesse muche amysse. And to the intent that you may confidre this matter the better, I think it good that you do marke hyr motion the more diligently hereafter: as in this presente moneth of Septembre, at the beginning of the moneth she was about 36 degrees behynde the sonne, and so shoulde she shine almoste 2 howers and a halfe after the sonne, as it myghte appeare by the degrees of distaunce. but consideringe the obliquitie of the Zodiake, and the latitude of Venus at that time, she didde scarce shine three quarters of an hower after the sonne.

Scholar. This talke is to obscure for me yet.

Master. I knowe it ryghte well. but yet I thoughte good to admonish you in that matter, least at any time you shuld fynde the doubte, when you shall haue no opportunity to aske councell therein: but now to proceede before the eand of the same moneth of Septembre, the sayde Planete wyll be cleane hydde with the sonne beames: for within 2 dayes after (I meane the second daye of Octobre) she doth ioyn with the sonne by coniunction. And frome that daye forward the sonne doth outgo hir so faste, that by the 13 daye of Octobre, she wyll be out of his beames againe, and ryse almoste an hower and a quarter before the sonne. And at the eande of Nouembre, she will be 46 degrees behind the sonne, in ordre of the signes, and yet shall she rise 4 howers and more before the sonne, where as the numbere of degrees are equall to lyttle more then three howers. but the obliquitie of the Horizont, doth make all the diuersitie in this, excepte a meane trifle by the latitude of Venus. And thus  
may

may you marke Venus in all that moneth, and in Decembre also vnto the eande of the yeare: but then dooth she abate her distaunce againe, wherby it is easye to vnderstande that she hath a seuerall motion from the sonne, and a seuerall sphere also.

Scholar. In Venus it doth appeare nowe easye inoughe to confidre, as well as in the Sonne and Moone: but is it as easye in the other four Planetes?

Master. Yea in deede, for three of them which bee moste highest, if you lyst to learne to knowe them, and to marke their courses: but Mercury is not so well marked, bicause he doth alwaies keepe his course nigh about the sonne, and therefore his obseruation requireth greate diligence, and his courses appeare most straunge, yet bothe he and Venus do accomplishe their course in a yeare with the sonne: but Sa-

Mercury

Saturne

turne is so slacke a mouer, that you shall not well perceau his motion vnder 4 moneths. in which time he doth moue about 4 degrees: so that if you marke his place at any time, and within 4 monthes after that time yf you do marke him againe, you shall perceau that hee is gone 4 degrees eastwarde, whiche you maye marke by the fixed starres aboute that place: but if you doo after a whole yeare marke hys place, then shall you perceau well and manifestly, that hee is gone eastwarde 12 degrees, and somewhat more: as for example. The fyrste daye of Septembre, the laste yeare 1555 Saturne was in the 12 degree of Aries, and this yeare of 1556 we see him to be in the 26 degree of the same signe, wherby it dothe appeare, that he hath moued 14 degrees eastwarde in that yeare space. And if you will haue farther prooffe: In the yeare of our Lorde 1549, the laste daye of Nouembre, Saturne was seene in the 26 degree of Capricorne, and this yeare of 1556 the fyrste of Septembre, the same starre was in the 26 degree of Aries: wherby it maye bee knowne that hee hath moued three whole signes (whiche is a quarter of the Zodiake) in 7 year space. And so in lesse then 30 yeares,

he

hee dothe go about the whole Zodiake.

*Iupiter.*

Iupiter hath a swyfter course, for he passeth the circuite of heauen in lesse then 12 yeares. so doth he every yeare run ouer one signe, and euery two moneths he passeth 5 degrees.

*Mars.*

Mars is yet swyfter in course then hee, and compasseth all the Zodiake in 2 yeare, and euery moneth passeth halfe a signe. wherby for this point, he is more easy to be marked, then anye of the other. but yet are his motions difficulte to marke in other pointes: but this may suffice for tryall that he moueth eastwarde, as all the other Planetes do: and therefore must he be iudged, as all the other also oughte to haue feuerall spheres in whiche they moue. And although theyr spheres can not bee seene, yet in as muche as their starres maye be so well perceaued, it muste needes follow, that they haue spheres also: except we shuld come to that absurditie to saye, that they moue in the Ayer as byrdes do, or as fyshes in the water: whiche were to muche repugnante to any one ordrelly motion, and much more disagreying to so many diuers motions as are in the Planetes, but namely in Mars and Mercury. And to the intent that you may know them the better, it shall bee good that you learne their true places by the Ephemerides; and accustome your selfe to loke for them, and to marke their bignes and colours how they differ from other starres. whiche is spoken by waye of exhortation only, and not propounded as anye peece of this booke, but an other time I will instructe you better therein.

Scholar. But in the meane time, howe shall I know whether there be anye more spheres or no?

*of the ninth  
and tenth  
sphere.*

Master. There is thought to be in the 8 sphere or Firmament, two other motions, whiche be disagreeable from all other mouinges before mentioned, and therefore many thinke that they muste of necessitye confesse 2 other spheres from whiche those motions must procede peculiarly.

Scholar. What motions are those, and howe are they knowen?

Ma-

Master. Fyrste there is one notable obseruation by conference of learned men in diuerse ages, concerning the Equinoctiall pointes, and lyke waies concerning those Tropical pointes; that the Sonne toucheth twise every yeare: for about the incarnation of Christ, the equinoctiall point or instaunte happened aboute the 25 daye of Marche, and nowe it is aboute the tenth of the same moneth, whyche disagreement dooth ryse partly by the misse ordre in the Leape yeares, but mooste principallye thorough the anticipation of the Equinoctiall tearmes. For althoughe the Sonne doo at the yeares eande retourne to the same poynte in the Starrye skye where hee was at the beginninge of the same yeare; yet is he not exactlye so nighe vnto the Equinoctiall pointe as he was before, but doth ouer runne it every yeare, and thereby in continuaunce of tyme it cometh to passe, that men may sensibly perceauie that the stars are runne eastward from that equinoctiall point.

Scholar. This seemeth something obscure, excepte you can declare it more plainely.

Master. Do you not confidre betwene the sonne and the moone, that when she doth ioyne with him by coniunction and then ouerpasseth him by her swyfte motion, that when she retourneth againe to the same place where she dyd leaue the sonne, she doth not fynde him there, but she must ouer go that place, beefore shee canne ouertake the Sonne againe, by reason that the sonne dydde moue forward after the moone in the same course, though muche more slowly: So likewise when the Sonne departeth frome anye starre in the skye, in the verye instaunt of the equinoctiall equalitye, and in the very point of the intersection of the Equinoctiall and the Ecliptike line, where of necessity that equalitye must happen: if the sonne retourning after a year vnto that Equinoctiall pointe, do not fynde the starre there precisely, whiche he lefte there, but that he muste ouer run that point, before he cā come again to þe said star, may not we yea  
&.i. and

and must not we saye, that that starre is moued forward in his course eastwarde, as all the Planetes doo moue? Howe bee it the quantitie is so lyttle, that it is not perceaued by syghte alone, nother yet by instrumentes; in lesse then an hundreth yeare, so that no one man is hable to marke anye greate diuersitie in hys owne age, but must be fayne to conferre with other men that hathe made obseruations longe beefore and written them: so dydde Ptoleme conferre his obseruations, with Hipparchus obseruations, and found that from Hipparchus tyme vnto his owne age, the Fixed starres were moued forward from the Equinoctiall pointe, two degrees, and 40 minutes: whereby he dyd coniecture, that they moued euery hundreth yeare one degree, syth the tyme betwene their 2 obseruations was 265 yeare: and after the like rate was the same motiō found by conference of the obseruations of Timochares & Hipparchus. what other mē say for more precisenes herin syth their tyme, I wil in þ The orikes declare vnto you: but all agree herein, that the starres do moue vniformly with all their sphere eastward as the Planetes doo. wherefore many assigne that motion as peculiar to the eight sphere, and the daily motion from east to west they appoint to the nynth sphere. Other men perceauinge that the starres doo also ascende northwarde, and descende againe southwarde, doo assigne a certaine motion, whiche is named by them *Motus trepidationis*, and they note it to bee peculiare for the eighte sphere, and the other motion laste named beefore, they accompte to be propre to the nynthe sphere, and then of necessitye it foloweth, that a tenth sphere (as they saye) muste be assigned for the daily motion.

Scholar. If it be true that there be suche varieties of motions, then it seemeth reasonable to assigne so many spheres as there be motions seuerall.

Master. Although you thinke so now, you may be persua

ded peradventure to thinke the contrary hereafter, as most wise men in that arte do.

Scholar. But in the meane ceason what shall I thinke?

Master. Thinke well on that that you haue learned, and labour to be expert in all that, by often conference of your learnynge, with the practise of the globe, and so shall you be apte to bee instructed in all the reste the more easilye. for it will requyre a witte somewhat readye, and practised in these former matters.

Scholar. I wyll then prepare me a Sphere (without which I see I can doo lytle good herein) and so will I practise these former lessons, that I truste to be as readye in them, as any auditor in framynge of accompte.

Master. By that meanes shall all other thinges in thys arte appeare easye vnto you, whiche nowe myght seeme vntimely put forth, if I shoulde offer to teache them, as the motions of the Sonne, Moone, and other Planetes, with their eccentrices, equantes, differentes and Epicycles.

Scholar. In deede I thinke this to harde yet, but of the progression, retrogradation, and station of the Planetes, and also of the eclipses of the Sonne and Moone, I knowe that Iohn de sacro Bosco dyd write somewhat, and so myght you brieflye nowe do.

Master. His woordes are shorte and therefore obscure, and so should my wor des be. beside that, it is a disordrely forme to put the carte before the horse: I meane to write of the passions of the Planets, before I haue sufficiently taught the full ordre of their motion. Therefore I will saye in fewe wordes, that the reasons of the passions canne not bee taught aptely, before the Theorikes of theyr motions. but for contentation of your mynde, I maye define after a sorte the eclipses of bothe the Sonne and Moone: wher-  
of the fyrste is but an appearaunte and a countrefete Eclipse: and is no wante nor losse of the lyghte in the Sonne it selfe, but is an impedimente, that hys lyghte  
& .ij. dooth

The Eclipse of  
the Sonne.

The E-  
clipse of  
the moone.

dooth not or can not extende vnto vs, by reason that the moone doth runne beetwene him and our sighte. And this Eclipse as it hydeth the sonne from vs for a time, so in some partes of the earthe at the selfe same instaunte he is not anye whitte eclipsed, but shyneth cleerely and wholly. And therefore is that eclipse called no Generall eclipse, whiche should extende to all the worlde, namely for that hemispherye, but is particulare for some one climate, and yet not vniuersall to all that climate. but contrarye waies the eclipse of the moone is a true eclipse in deede: for there is no thinge that runneth betweene our syghte and her, and so hydeth frome vs her light, but she leeseeth her light certainly. As if a glasse that standeth in the Sonne, doo receaue the lyghte of the Sonne, and doo caste beames (as wee maye see) frome hym, tyll some cloude or some other darke bodye passe betweene the Sonne and it, and then it leeseeth hys lyght cleerely, and hathe no lyghte but hys owne bryghtnesse, whiche canne cast no beames, nother deserue anye name of lyghte, in comparison to the lyghte that it hadde of the Sonne: So the Moone kepyng her course tyll shee bee at the full, that is to saye, in the contrarye poynte of the Zodiake to the Sonne, and that then shee bee without all latitude, and runne ryghte vnder the Ecliptike lyne in the Zodiake, then dooth shee lyghte directly in the shaddowe of the earthe, and therefore canne not receaue the lyghte of the sonne, but leeseeth it for the time, howe bee it not alwayes a lyke. for sometime shee cometh whollye withoute the shaddowe of the earthe, and then is shee whollye eclipsed: at other times shee cometh but partely into the shaddowe, and that some tymes in the ouer parte, and sometime in the nether parte, whereby shee is eclipsed partly, and not vniuersallye: for if the moone passe by the northe or ouer part of the shaddow, and touche it with anye parte of hir selfe, then is that parte eclipsed

eclipsed of necessity, which is the southe part of the moone or the nether part of her. And again if the mone do touch the nether parte of the shaddowe whiche is nexte to the Horizonte, then is the hygher or northerlye parte of the Moone eclipsed. To tell you nowe of the Eclipticall pointes, whiche be commonly called the Headde and the Tayle of the Dragon, it were verye vntymely, and harde for you brieflye to conceaue, and therefore I do willingly omitte them.

Scholar. Yet this I perceau by you, that the sonne is not darkened in him selfe, but is hydde by the moone from vs, whiche happeneth diuerslye: for sometyme all the Sonne is hyd, and sometyme the hygher part only, and at other times, the nether parte onlye. of all whiche formes, I may see examples on euerye common Almanach after a grosse



fort: but this Figure doth more aptlye expresse the cause thereof: where the Moone dooth appeare to be betweene any one Region and the Sonne, and therefore hydeth the Sonne from the inhabitauntes of that place: but in other Regions there appeareth no suche lette of the Moone, but that they maye fully see the Sonne. And other Nations bee-

tweene them, see parte, and leese other parte.

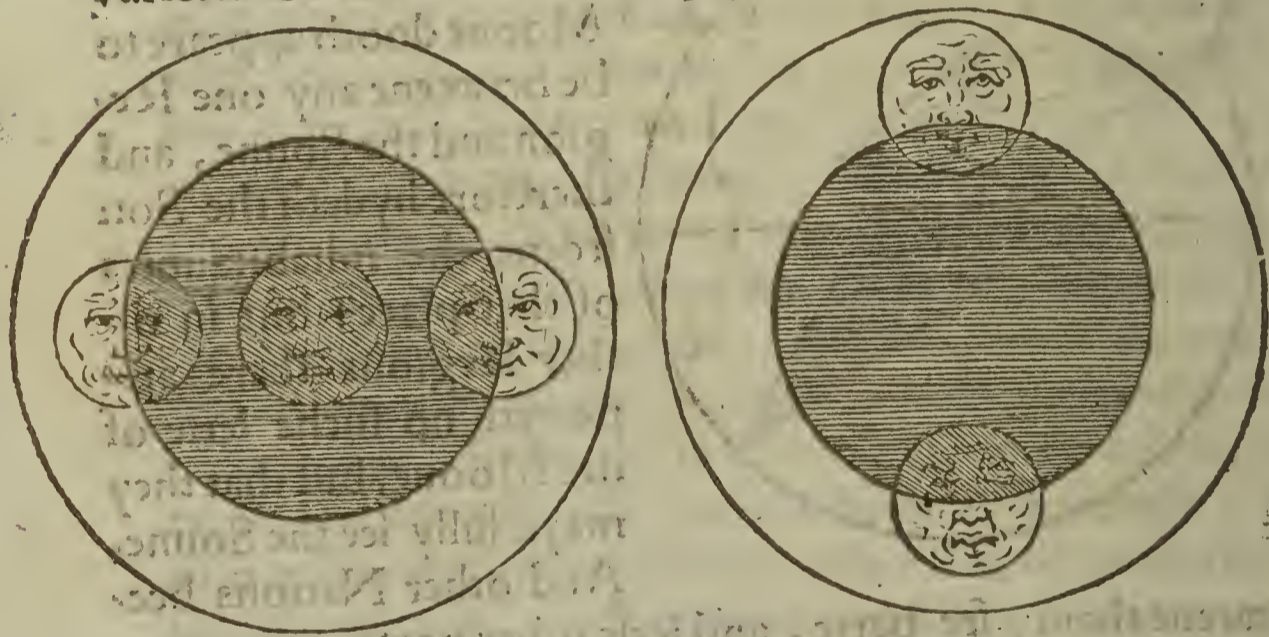
And thys I perceau maye bee considered dyuerselye, in as muche as anye bee nygher to theym that see the whole Sonne, or nygher to those that see hys Eclipse.

&.iij.

Ma

Master. There is in that nighnes double consideration: one is of distaunce betwene easte and weste, and þ other is of distaunce betwene southe and north. for when any nation doth perceauē the higher cante of the sonne enclipsed, then they that dwell more northerly, (vnder the same meridian) do leese more of the sonne, and iudge that eclipse the greater: and contrary waies they that dwell directly towards the southe, the farther south they dwell, the lesser doth the part eclipsed appeare to them to be, tyll at lengthe vnto them that dwell more southe there appeareth no eclipse at all. The seconde consideration betwixte easte and weste, dooth cause only diuersity in time of the Eclipse, but not in form: & that is cōmon also for the eclipse of the Moone, but so is not the first consideration, but serueth for the sonnes eclipse onlye.

Scholar. As for the eclipse of the mone, I thinke the former figures whiche you did shewe me, do comprehendē all varieties of formes sufficiently, whiche be these two, for the



other two do represent those false formes, that do follow of certaine false figures of the earth: and therefore do not serue here in place of true doctrine.

Master. This may you now also confidre, that although the eclipse of the sonne is not general to all nations, bicause  
it is

it is not a true eclipse or wante of lyghte, but onlye an apperaunte eclipse, yet the eclipse of the moone is a very Eclipse in deede, that is to saye, a wante of lyghte in hir selfe, & therefore who so euer doth see her, dooth see also hir eclipse exactlye as it is: and it appeareth vniformlye to them all, though at that time the moone be not, nor canne not bee aboute the horizont to all people: and therefore vnto them that haue the moone vnder their horizont, it is accompted none eclipse. And that is the cause why many eclipses of the sonne and moone also are not noted in the common Ephemerides and Almanachs, bicause they appeare in such time as the Planet eclipsed, is vnder the Horizont of that region for whiche the Almanach or Ephemerides is written. farther more this is to be considered as a very truth and most vnfallible, that the eclipse of the son can neuer happen but at the verye chaunge of the moone, for at other times shee is so far in ordre of hir course from the sonne, that shee can not hyde any parte of him from anye nation in earth. And for the eclipse of the moone, the time of opposition or full moone doth serue only. for the shaddowe of the earth whiche alwaye runeth towarde the Nadir of the sonne directly, can not touche the moone, excepte she be verye nighe vnto the same place. And that is the cause why the eclipse of the sonne whiche happened at the deathe of Christ, may not be accompted a naturall eclipse, for so muche as it happened in the time of the full moone, when it is not possible by natures ordre, that anye suche eclipse shoulde happen. And therefore dyd Dionyse & Areopagite beyng in Alexandria, and Apollophanes his companiō, not only wonder at this straung and vnnaturall eclipse, but concluded that it could not happen without some meruailous cause, and a wondrefull immutation of natures workes.

Scholar. So dooth our author of the sphere note it, affirming that Dionyse dyd say then: Other doth the God of nature suffre now, or els the whole frame of the world shall

nowe be dissolued.

Master. With this good clause did he eande his booke, and so wyll we with the same eande close vp our talke. Learninge this good vse in this naturall arte, that it leadeth me wonderfully to the knowledge of God, and his highe mysteries. as not only by example of these twoo philosophers here it doth appear, but by the testimonies of the scriptures in fundry places.

Scholar. This was that Dionyse, whome Saincte Paule dyd conuerte afterwarde at Athenes, and rather muche because he hadde in remembraunce that miraculous Eclipse.

Master. So maye wee gather manye argumentes by lyke maters against infideles and false Christians also: but that frute will I reserue for an other place: and for this presente will only saye, that there was neuer any good Astronomer, that denyed the Maiestie and prouidence of God, though many other denyed bothe: but nowe farewell for a time: I am dryuen to omytte teachinge of Astrononye, and muste of force go learne some lawe.

Scholar. The god that is author of true Astrononye, and made all the heauens for men to beholde, keepe you in healthe and cleare from all trouble, that you maye, as you mynde, accomplyshe your workes, and finish well and speedily, the frutes of your studye.

Master. Amen, and Amen.

## The titles of the fourthe Treatise.

What occasions moued men fyrste to iudge the forme of the worlde to be rounde, and namely three principall reasons thereof.

That the heauens are rounde in forme contrarye to the errour of Lactantius Firmianus, whiche thoughte it to bee flatte, and his opinion confuted by diuers reasons, namely by the vewe of the starres, by aptenes of inouynge, by reason of capacitye, and auoyding of emptines.

That the Firmament doth moue, though Lactantius thought the contrarye: and howe it maye be proued, especially by the Milkye waye. And that the starres doo not moue as byrdes in the ayer, or as fyshes in the water.

That the heauens are not cornered, nother of manye angles.

That all thinges shewe greater then they be, thorough vapours, and therfore the starres with the Sonne and Moone doo appeare greatest nigh vnto the Horizont.

Dyuerse opinions of the forme of the earthe: some thinkinge it to be of Cubike forme, other iudginge it Rygge formed, other affirmynge it to be plaine, other deeminge it hollowe as a dyshe, and other esteemyng it longe and rounde, lyke a pillar or roller: all whiche beyng sufficiently confuted, it is full proued, that the earthe is iustly rounde in shape.

Then followe diuerse reasons, approuynge the water to be round, and a declaration with prooffe why the water dooth not, nother can not ouer-ronne the whole face of the earth.

That the earthe and water together doo make but one rounde Globe, and haue therefore one common centre.

That the earth is but as a pricke in comparison to the Skye, which is approued by foure dyuers argumentes.

The distaunce of euerye sphere frome the centre of the earthe, with an ordre to trye the quantities of the Sonne and Moone &c. in comparison to the earthe.

That the earthe is in the myddle of the worlde, and the contrary opinions repeated and confuted by sondry proofes.

That the earthe dooth not moue from the centre of the worlde.

A brieue reherfall of the parallele circles, with an instruction howe to fynde the distaunce of the Tropikes, and the greatest declination of the sonne, and of euerye degree of the Zodiake from the Equinoctiall circle.

That the Arctike and Antarctike circles are not permanente, but mutable, accordynge to the chaunge of the regions, and so their quantities varieth, and their distaunce altereth, in respect to thother paralleles: and their ordre chaungeth diuersly.

The Zones beyng immutable, ought not to be distinct by the Arctike and Antarctike circles whiche are mutable, but rather by the Polare circles whiche perseuere styll, and keepe their quantities, their distaunce and their ordre yniformly.

That

- 16 That there ar no Zones vninhabitable other for heat or could, but may be and are also inhabited, as it is well knowen.
- 17 The Zodiake is named of the twelue Signes, whiche signes are taken in diuers significations. and howe any starre or Planete is named to bee in any signe. also what is the longitude, latitude and declinatiō of any starres or Planetes.
- 18 The Colures, what they be, and howe many in numbre, and whereof they take their name.
- 19 The Horizonte celestiaall and terrestriall, howe they be distincte: where Proclus sentence is reprehended, and thre seuerall tables set forth for distinction of howers, according to distaunce of myles from easte to weste, and that for diuerse climates.
- 20 The ordre and numbre of the Climates, with the eleuation of the Pole and the quantities of the longest daie in eche of them.
- 21 Of ascention Astronomicall and Poeticall, and how euery one of them is distincte. with certaine rules of ascention Astronomicall, and tables for the same, bothe in the Ryghte sphere, and also in diuers Oblique spheres. with an examination of the rules of Iohn de sacro Bosco.
- 22 The distinction of howers into howres equall, and howers vnequall: and that howers vnequall be considered in twoo diuers sortes, with tables sette forthe for eche sorte, concerninge their quantities.
- 23 Of daies Artificiall and Naturall. and what are the causes of diuersitie in eche of them, with tables for the quantities of the same: and a declaration of the Sonne rysinge and settinge.
- 24 The names of the constellations, with the numbre of their starres.
- 25 A brieue declaration of the motions of the Planetes, and consequently a reasonable prooffe for the numbre of their spheres. And farther what occasion there was, that men should imagine the ninthe and tenth sphere to be, where as there can none be seene aboue the eight sphere.
- 26 A shorte explication of the eclipses of the Sonne and the M oone.

Though faultes ofte times doo muche abounde,  
 When men doo leaste suche chaunce suspecte:  
 Yet good redresse maye soone be founde,  
 If faultes bee spied and full deteete.  
 But who that will in woorke proceede,  
 And seeke not firste the faultes tamend;  
 I promise him smalle gaine in deede,  
 Though he truthe to seeke hee doo pretend:  
 Therefore amend if thou wilt speede  
 These faultes; ere thou on me doo reade.

The fyrste numbze signifieth the page, the second the lyne of the page.

9.28, sphere which is. 10.12, eight sphere. 10.29, prooffe of my wordes  
 and in the meane reason to procede as I began: you must. 17.17, doth. 18.1  
 the semicircle. 18.15, σφαιραι. 21.7, κύκλος. 23.10, ἰσημερία. 24, in the fi-  
 gure H, must be set by the mydle lyne against G. 25.26, χειμερινή. 27.8,  
 κύκλω. 29.17, moueth or runneth. 30.7, οὐρανός. 32.22, there 2 circles.  
 33.22, drawen. 34.21, declareth. 36.18, and thorough. 41.17, they do. 56.12,  
 to the colures. 57.35, their formes. 63.34, by their qualities. 68.17, call the  
 latitude. 80.22, round aboute. 89.35, accordyngly. 97.20, at home. 103, in  
 the margent, lib. 3, c. 24. 106.11, although. 106.33, heauen. 111.6, most apte  
 of all other. 114.31, the rygge. 114.32, the one. 116, in the margent, the re-  
 proffe. 117.21, instaunte. 121.19, the fiste parte. 121.20, the fiste parte. 124, in  
 the margent is the lyne wronge sette. 136.18, that is by D. 136.24, that is  
 by B. 145, and 146, the foure figures are not well placed in ordze, for the first  
 should be the thyrde, the seconde should be fyrste, and the thirde ought to be  
 second. 147, set D vpon the greatest shadow, and E vpon the myddlemost.  
 153.11, 33 minutes. 171.4, folwly. 172.8, ὕψος. 177.9, Arcturus is in libra  
 &c. aboute 31 degrees. 180.35, And H & L the 2. extreme points on the earth,  
 vnto whiche &c. 186.23, stand. 189.5, at an other time. 192, in the figure of  
 the climates, B and D should stand lower against the double lyne, which is  
 the Equinoctiall. 194.23, confidze. 207, the line in the example is wronge  
 placed. 212.1, differeth not in this table the fyrst. 212.16, 180 degrees. 233.16,  
 of proportions. 245.22, the daye is not. 248.20, reiect that ordze. 248.33,  
 is not regarded. 260.10, the titles sette. 266.12, protrygetes. 270.3, ryghte  
 wynges. 272.1, fiste and the.

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